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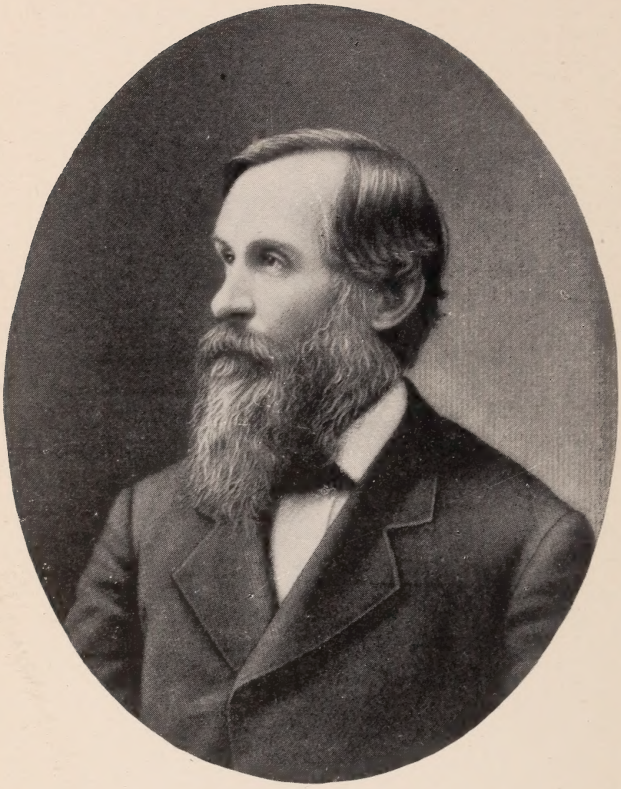


J. BERRIEN LINDLSEY, M. D.

In Memoriam.

JOHN BERRIEN LINDSLEY, A. M., M. D.

Born October 22, 1822.
Died December 7, 1897.

Dr. John Berrien Lindsley of Nashville, Tenn., became a member of the American Public Health Association in 1877, and he held the office of treasurer of this organization from 1879 to 1891. His birthplace was Princeton, N. J., and he was descended from Revolutionary ancestors, his grandfather Nathaniel Lawrence having been a gallant soldier in the American army, and afterward attorney-general of the State of New York. Dr. Lindsley was educated at the University of Nashville (A. M., 1841), and was graduated in medicine from the University of Pennsylvania in 1843. Dr. Lindsley's mental endowments were extraordinary, and he was recognized by his associates at an early period of his career as possessing tireless industry and unbounded energy. He engaged but little in active practice, but devoted his life mainly to educational and literary pursuits.

He commenced the teaching of medicine in 1850, holding successively the chairs of chemistry and pharmacy in the Medical Department of the University of Nashville until 1873, and was dean of the faculty of that institution until October, 1855. He was health officer of the city of Nashville from 1876 to 1880; professor of chemistry and state medicine in the Medical Department of Tennessee, and for many years secretary and executive officer of the Board of Health of the State of Tennessee.

Dr. Lindsley's activity was not confined to the limits of medicine and public hygiene, but he also aided in the establishment of the public school system of Tennessee, and contributed to periodical literature many articles upon philanthropic, religious and political topics. One of his biographers has said of Dr. Lindsley that his passion was "to study, to learn—ever to increase his store of knowledge."

Dr. Lindsley was buoyant and hopeful, and these characteristics governed his attitude toward the great questions relating to hygiene which were presented during the twenty eventful years of his membership in the American Public Health Association. He was uniformly progressive and optimistic in his views, and he possessed unbounded confidence in the successful development of the sanitary awakening

which had its rise during the period of his greatest activity. He was a pioneer in the administration of state and municipal hygiene, and his work exemplified his deep conviction of the value to humanity of measures for the protection of the public health. He was beloved and respected by his associates in this organization, and the records show that in his official relation he was accurate, upright and honest. He leaves the memory of an honorable life sincerely devoted to truly noble ideals.

GEORGE HENRY ROHÉ, M. D.,

PRESIDENT OF THE AMERICAN PUBLIC HEALTH ASSOCIATION.

SEPTEMBER 30, 1898.
FEBRUARY 6, 1899.

As the fraternal friend for many years of our late associate and president, George Henry Rohé, I have been asked to add a stone to the cairn, which shall perpetuate his memory in the archives of this body. The frequent mention of his name throughout the Transactions of the American Public Health Association since 1876 are the evidences of how his enthusiastic and progressive spirit and ability as a sanitarian pervaded its fabric and identified him as one of its constituent parts. I alone know fully with what profound gratitude he was moved by the fulfillment of his unasserted ambition to merit its highest office. He regarded the presidency of the American Public Health Association as the patent of noble work well done, attested by a body of men who collectively represent the highest philanthropy of advanced civilization.

The details of his biography have been set forth by his successor in the presidential chair, in numerous professional periodicals, and extensively on the occasion of his untimely death in the secular press. He was born of Bavarian parentage on the 26th of January, 1851, near Baltimore, receiving his early education in the schools of that locality, where he commenced the study of medicine in 1867 with Professor Augustus F. Erich, being graduated in March, 1873, from the School of Medicine of the University of Maryland and becoming afterwards a student of dermatology with Dr. Edward Wigglesworth of Boston, in which specialty he subsequently became a recognized authority. For a few years, he enjoyed that higher education and preparation for mature work which comes from travel, beginning his career at New Orleans, where it was destined he should end it, later (1879) becoming a member of the Howgate Arctic Expedition. Ultimately he returned to Baltimore, engaging in the practice of his profession, wherein he soon attained distinction. In 1881, he became a member of the faculty of the College of Physicians and Surgeons of Baltimore, filling the professional chairs of Materia Medica, Therapeutics, Hygiene and Mental Diseases. In 1885, he was appointed Acting Assistant Surgeon, U. S. Army.

An able, fluent and graceful writer, his contributions early attracted attention, especially in the direction of public sanitation, of which he had become an enthusiastic advocate from the outset, and his promi-

nence in which led to the tender to him, in 1890, by Mayor Davidson of the office of Commissioner of Health of the city of Baltimore, which he administered so ably that when the Governor of Maryland offered him the Superintendency of the State Hospital for the Insane at Spring Grove, it was generally considered that the right man for the place had been found.

From the day of his installation disappeared every trace of the Lunatic Asylum. The house of restraint became a sanatory home—a hospital for the insane. Bolts, bars, shackles, manacles, straight-jackets and padded cells went to the museum as exhibits of man's unenlightened cruelty to man. His influence towards a reformed ministering to this class of the unfortunate sick was quickly felt and appreciated, but his efforts were naturally limited by existing conditions in a building erected when other ideas were in vogue, and consequently when the Legislature of Maryland authorized the erection of a new establishment it was conceded that he was the one to whom should be given the task of selecting the site, designing the buildings and inaugurating its administration. Accordingly, the Governor of the State in 1896, commissioned him as the Superintendent of the Second Hospital for the Insane of the State of Maryland, and so well did he fulfill the trust reposed in him that the succeeding Governor, though of an opposite political faith, confirmed the selection of his predecessor, thus securing his continuance in office whichever the party in power.

With commendable diffidence he sought the advice and assistance of the ablest men in the profession. Professors Welch and Hurd of Johns Hopkins Hospital were associated with him on the commission to determine the site and character of the new establishment, and after personally inspecting the latest and most elaborate institutions for the care of the insane, in the United States, a location at Springfield, in Carroll County, near the town of Sykesville, thirty miles from the city of Baltimore, was unanimously chosen. With a domain of nearly eight hundred acres, well-wooded and watered, with exceptional facilities for drainage, with the old Patterson manor-house as a domicile for the Superintendent and well-appointed farm buildings as the nucleus of contemplated structures, he set himself at work to found an institution which should be the best of its kind in the world, and expert comment is that "here the problem has been solved, so far as human intelligence can do it, of the humane treatment of these unfortunates, whose minds have gone adaft. Here amid the placid surroundings of rural life, away from every exciting cause, with agreeable outdoor occupation, the unbalanced mind may recover its equilibrium, or if that cannot be, if healthy living, wholesome food, and generous indulgence cannot effect a cure, the inveterate sufferer can at least live

peacefully, decently, and, as far as the fantasies shaped by his seething brain will permit, contentedly."

Further quoting an article[1] written when I had no thought it would serve this obituary purpose: "The distiguishing features of this new establishment for ministering to men with minds diseased may be briefly stated to be: (1) Impressing upon the inmates the fact that they are patients under treatment in a hospital; (2) dispensing with every form of mechanical or visible restraint or irritating means of compulsion; (3) finding appropriate occupation, especially outdoor work for every one, utilizing the skilled labor of mechanics, or giving the Polish Jew, who never knew other instrument than the needle, the task of mending clothing and bedding; (4) encouraging and exacting habits of personal cleanliness, water-closets, urinals, lavatory-basins or rain-baths, soap and towels being provided on every floor in apparent superfluity; (5) instituting a quasi-military precision and regularity in the associated operations, in dressing and undressing, in beginning and quitting work, in going to bed and rising, bugle-calls, so far as possible, supplementing personal orders and the uniformed attendants acting rather as captains and guides than as keepers or guards. What can be accomplished toward humanizing these unfortunates is most strikingly illustrated at the general weekly inspection by the Superintendent on Sunday morning, when every nook and corner are explored with a thoroughness that bespeaks the military antecedents of Major Rohé. Having been more than once invited to act as inspecting officer and urged to indicate defects and oversights, for which twenty years' experience in charge of United States Naval Hospitals perhaps qualified me, I bear witness to the wonderful results that have been here accomplished, and probably that very experience of which Dr. Rohé had been a frequent onlooker in the course of our long intimacy, had, as indeed he declared to be the case, a suggestive share in the semi-military character which he found so great an aid to executive system and discipline as well among attendants as patients.

"The State of Maryland has great reason to be proud of this unrivaled establishment, and the Board of Managers may congratulate themselves upon the trust they so implicitly placed in the judgment and acquirements of the Superintendent, who himself had the rare satisfaction of having seen his plans and promises fulfilled to the very letter. What he had accomplished in this superb institution betokens what should be expected in its further development. Simple, chaste, elegant in architecture and appointments, its broad halls, lofty rooms and admirable proportions and equipment cannot fail to please the critical visitor, while the man whose monument all this is, could have justly boasted that without stint of what was necessary, with lavishness only in the direction of the sanitary provisions of cleanliness, not one dollar has been expended for which a full equivalent is not in evidence."

It is the more regrettable that having outlined the work of a long life, which would have brought him distinction and honored his native State, he should have been stricken in its beginning. He had married, in 1890, Miss Mary Lauderman Coffin of Baltimore, a descendant of Tristram Coffin, the original settler of Nantucket in 1660, whom with his only child, a daughter of nine, he had taken to New Orleans, the

[1] *A Modern Madhouse: An Inspection Report*, by Albert L. Gihon, A. M., M. D., Medical Director United States Navy.—*The Philadelphia Medical Journal*, November 5, 1898.

scene of his earliest professional work, upon his appointment by the Governor as delegate from the State of Maryland to the National Prison Congress there in session, where he died suddenly on the 6th of February, 1899, eleven days over forty-eight years of age.

Member of a long list of American and foreign societies, ex-President of the American Association of Obstetricians and Gynecologists, and of the Medical and Chirurgical Faculty of Maryland, and at the time of his death of the American Public Health Association, his versatility was marvelous. A skilful gynecologist, a widely known dermatologist and author of a manual of skin diseases, of a work on Practical Electricity in Medicine and Surgery, for many years associate editor of the Annual of the Universal Medical Sciences, an authority in Sanitary Science and author of a standard text-book of Hygiene, a distinguished alienist, his monument stands at Springfield, where, as the Baltimore *Sun* declared in its announcement of his death, "a noble foundation has been laid with which the name of George Henry Rohé will always be associated in grateful memory."

I, who knew his inmost worth, bear glad testimony to his excellence as a man, his fidelity as a friend, his earnest zeal and fearless honesty of purpose in doing well whatever he undertook, and this he did incomparably well.

ALBERT L. GIHON.

Paris, France, 6 February, 1900.

PRESIDENT'S ADDRESS.

By Dr. HENRY MITCHELL,

Secretary State Board of Health, Trenton, New Jersey.

Mr. Chairman, Members of the American Public Health Association, Ladies and Gentlemen—It has become my duty to address you on this occasion because of the death, February 6, 1899, of the distinguished gentleman upon whom was bestowed, one year ago, the highest honor within the gift of this Association. Dr. George Henry Rohé was born January 26, 1851, near Baltimore, and was graduated in medicine at the University of Maryland in 1873. After several years spent in foreign travel he engaged in practice in Baltimore, until his appointment in 1891 to take charge of the Maryland Hospital for the Insane, a position which he held at the time of his death. Dr. Rohé was a member of many scientific organizations and he was appointed to the chair of hygiene and mental diseases in the College of Physicians and Surgeons, Baltimore, in 1881, and served as commissioner of health of Baltimore during 1890 and 1891. Dr. Rohé was the author of numerous papers published in the current journals and in the Reports of this Association; he was associate editor of the Annual of Universal Medical Sciences; author of a work on Practical Electricity in Medicine and Surgery, and of a Manual of Skin Diseases. His Text-book of Hygiene has reached its third edition, and is in general use in the institutions where hygiene is taught throughout the United States. Dr. Rohé's probity, and ability as a physician, educator and sanitarian, were recognized by his associates and by his fellow-citizens. Of him one of his neighbors has said: "He was superior in his professional attainments, and he was also social, agreeable and cultivated." Another says: "Dr. Rohé was one of those men to know whom it was to love him, and who, while witty, was possessed of the most uniform spirit of kindness." His genialty kept a smile continuously upon his face, and his tones of voice indicated his humane and gentle character. He was a keen and studious observer, and an industrious worker for the relief and benefit of his fellowmen.

"Far from his kind he neither sank nor soared,
But sat an equal guest at every board.
No beggar ever felt him condescend,
Or prince presume; for still himself he bare
At manhood's simple level, and where'er
He met a stranger, there he left a friend."

His life and deeds justly entitle him to the distinction of being decorated with the title of the presiding officer of the American Public Health Association, and his name will ever stand as worthy to appear in that illustrious group composed of his honored predecessors.

A kindly sentiment has given rise to a custom which calls for mention at this time of the names of other members of this Association whom we shall see no more. George E. Waring, C. E., of New York; John B. Hamilton, M D., of Chicago; Henry N. Avery, M D., of Minneapolis; William H. Rhawn, of Philadelphia; Alexander N. Talley, M. D., of Columbus, S. C.

This is the twenty-seventh annual meeting of this Association. Last year we met in the handsome Capital City of one of the three great countries represented in this organization, and previous meetings have been held in leading centers of population, always with the expectation of learning much, and also with the hope of awakening an increased local interest in the humanitarian objects to which our Association is devoted.

This year we meet in a city of the great middle-west, a city which has become identified in the minds of all Americans with the thrift, growth, and rapid progress in all of the arts of civilization which we are wont to regard as characteristic of this portion of the continent.

To the citizens of this locality this meeting is dedicated, and we pledge to them our sincere desire that they may especially excel in municipal sanitary administration.

It is my privilege to welcome to this gathering those who have come from distant points—from Canada, Mexico, and the various States of the American Union—to participate in the proceedings of this meeting, many of whom have risen to distinction as students, authors and teachers within the domain of hygiene, and others, representing local, State and National sanitary organizations, who have, in their official relations, become widely known and respected.

Those who are with us for the first time may be interested to dwell for a moment upon the origin and development of this organization, and to recall the fact that popularization of public hygiene in the three countries of the North American continent has been coincident with the rise and growth of this Association.

A conference between nine gentlemen in New York City, in April, 1872, was followed by the formation of a permanent association for the promotion of public health interests. At the next meeting, held in Long Branch, New Jersey, September 12, 1872, the organization of the Association was completed, and the objects, as set forth in the consti-

tution then adopted were to advance the study of sanitary science and to promote measures for the practical application of public hygiene.

That this movement was well timed is shown by the general interest evinced by the educated classes; membership being drawn from among physicians, lawyers, engineers, architects, educators, and from all of the other learned professions and occupations. From this beginning this Association has steadily advanced, always holding, with ties constantly increasing in strength, those who have once joined this alliance against preventable disease and premature death, and yearly attracting large reinforcements to carry on the work of presenting and critically examining each proposed addition to the theory and practice of the science and the art of public hygiene.

These annual meetings have proved attractive to health officers who are daily engaged in the practical application of laws and ordinances designed to promote health, and it is largely to this class of workers that credit should be given for the magnificent progress made in recent years in America in rendering operative the principles which this Association has from time to time discussed, elucidated and stamped with its approval.

Public interest in all questions relating to the development of a working system for carrying into effect the rapidly unfolding truths of sanitary science has been one of the most prominent features of the period which had elapsed since the Association was instituted. During this period have occurred nearly all of the substantial improvements in municipal sanitary administration which at present stand engrafted upon our systems of government.

I now desire to refer very briefly and in general terms to recent sanitary progress, and to speak somewhat more specifically concerning a few of the details relating to the prevention of disease, including sanitary legislation, education of sanitary officers, decrease of infant mortality, vaccination, typhoid fever, tuberculosis, adulteration of foods, and local, State and National sanitary administration.

The past year has been one of continued activity in every department of sanitary achievement. The extraordinary commercial prosperity which the country has experienced has stimulated and enabled local authorities to extend and perfect their defences against preventable disease. Public water supplies and sewerage works have been introduced into many towns in the United States, and new plants for cremating garbage have been installed. State and municipal laboratories for diagnosis now hold permanent place as necessary agents in the early and certain detection of several of the dangerous communicable dis-

cases, and the list of the affections which can thus be recognized is increasing.

It is gratifying to note that the postoffice departments of the three countries of North America have, in response to the advice and request of the American Public Health Association, permittted the transportation of specimens for examination in these laboratories, and that the work of these institutions has been greatly aided by the judicious adaptation of the postal regulations to the necessities of their operations.

Considerable progress has been made toward the adoption by State and municipal registration authorities in the United States, of a system for the classification of deaths, uniform with that already in operation in Mexico and Canada and in various European countries, and it is to be hoped that before the beginning of the year 1901 this movement will have found favor in many additional registration districts. This Association is to be congratulated upon the assistance which its influence has exerted in forwarding this very desirable improvement in the classification of deaths, and the judicious activity of those members to whom this subject was entrusted is worthy of high commendation.

The medical profession has ever evinced an active interest in preventive measures for the suppression of disease, and within the past few years this interest has increased in keeping with the advances made in knowledge concerning the nature of numerous affections which have been added to the list of those proved to be communicable, and this increased interest is indicated by the striking prominence recently given to public hygiene in various leading medical organizations.

There has been no abatement in the battle against this profession on the part of the self-styled Christian scientists, divine healers, osteopaths, et al., including antivivisectionists, the illogical tenets of whose faith continues to attract to their ranks a certain class of people—a class which betrays in its fanatical adherence to preposterous and obstructive vagaries unmistakable evidences of mental irresponsibility, becoming easy prey to the designing charlatans who reap a financial harvest by pretending to cure disease by incantations or other unscientific processes.

During the twenty-seven years which have passed since the organization of this Association, legislation designed to protect and promote the public health has been obtained in almost all of the States within the territory represented in the membership, and efforts are now being made to secure a greater degree of uniformity in these enactments and in the methods to be pursued in their enforcement, at least in so far as they are related to inter-state questions.

That legislatures have finally advanced more rapidly in providing authority for sanitary undertakings than local boards of health have

proceeded in the execution of the laws, is apparent, and one of the next great steps forward in promoting public health interests on this side of the Atlantic will consist in the extension of facilities for the instruction of the persons who are intending to pursue the business or occupation of sanitary inspectors.

A beginning has been made in this direction, and sanitary inspection has been recognized by a few institutions of learning in the United States as an art which demands on the part of its practitioners careful preparation for the duties and responsibilities of their calling, and instruction has been offered to those who are already engaged in the work of sanitary inspection, and also to those who may desire to take up this employment.

Objection is made that no system for the instruction of sanitary inspectors can be satisfactorily conducted until the service of those who become competent to perform the duties demanded of these officers shall be better appreciated by the public, and be better paid by municipal authorities, but it appears that the supply must anticipate the demand in this instance, otherwise local sanitary authorities will have no opportunity of learning the advantages which attend the employment of men who have been properly prepared to perform the complex and highly skillful labors required in detecting and curing the various conditions which endanger or impair the public health. Who without training is qualified to expose the dangers which exist in the food supply; to investigate and point out errors or fraud in the plumbing, ventilation and drainage of buildings; to disinfect dwellings; to direct measures for the prevention of the spread of communicable diseases? Shall we doubt that as soon as suitable institutions shall have fully established the requisite courses of instruction, that applicants will appear who will desire to prepare themselves for appointment to positions in the employment of municipalities, and that boards of health will be disposed to secure the service of trained men, and be willing to recommend the payment of a reasonable compensation?

A sanitary education is no less needed for administrative officers than for inspectors, and it is to be hoped that the colleges and universities of America will soon follow the example of the sixteen English institutions which now offer a post-graduate course in hygiene, and grant diplomas in public health.

This age of progress in which our lives have happily been cast has witnessed no more remarkable achievement than the reduction of mortality which has attended intelligent application of the newly acquired knowledge of the etiology of certain communicable diseases. The recent decrease in deaths from the diarrhœal diseases of children has commanded the attention of parents and statesmen as well as sani-

tarians, and there is no dissent from the opinion that the most important element in the enormous saving of child life which is now occurring consists in a better understanding of the dangers attending the use of unclean milk, and it is reasonable to believe that still more gratifying results are to follow, for thus far the protective measures against infected milk have been almost entirely applied to this article of food after it is delivered to the customer, but when producers shall intelligently and faithfully adhere to the laws of asepsis in the collection, cooling, storage, transportation and delivery of milk, then will we be able to learn the true value of hygiene, so far as it affects the food of infants.

The hygienic control of milk supplies has assumed a better working basis in numerous localities, and the popular demand for clean milk is beginning to meet with response from a few of the more progressive dairymen. The dilution of milk by the addition of water is attracting less attention from sanitary officers than this form of adulteration at one time commanded, but greater interest attaches to the source of the water with which the producer or dealer dilutes the milk. By aid of the lactometer the dealer is able to "water" and "skim" with a high degree of skill, and the consumer has the satisfaction of receiving a product having almost unvarying uniformity so far as its specific gravity is concerned, and if the water is taken from an uncontaminated source, the seller and buyer may adjust the dilution question by an adjustment of the price. But cleanliness of the milk and its freedom from pathogenic bacteria constitute another and a very much more important line of inquiry for the sanitary officer, and he recognizes the demand which consumers are making for milk which is produced on clean premises, by clean persons, and which is collected and sold under conditions which protect it against contamination. Pure water, and no other; ice from water which is fit to drink; healthy cattle; clean, well-lighted and well-ventilated stables; clean utensils; freedom from infectious diseases on the part of persons engaged in handling the milk—at least all of these features are imperatively required in conducting the modern dairy. The spread of typhoid fever through milk which has become contaminated by the use of water from polluted wells or springs on dairy premises is so frequent in its occurrence that a revolution in the milk business has long been demanded by sanitary authorities, but few producers and dealers yet realize their responsibility for the thousands of premature deaths which are directly due to the door-yard well. The penalties thus far provided for selling milk contaminated by the emanations or discharges from persons sick of any communicable disease are generally too insignificant to meet the necessities of the case,

and they fail to promptly produce a sufficiently deterrent effect upon ignorant and heedless persons, and instead of minor punishments an impressive fine and a term of imprisonment should follow violations of the laws of cleanliness which are fixed by nature as essential to the safety of consumers of milk.

The history of the morbidity in the military camps of the United States during the recent war with Spain has demonstrated anew the truism that cleanliness of water and food is an indispensable condition of health, and typhoid fever by its prevalence in these camps has further justified its selection as a typical illustration of the value to the public health of a rigid application of the principles of hygiene. The frequent occurrence of this disease in rural districts, particularly in lumber camps, mining camps and upon farms has, by common consent, been ascribed to the violation of well known natural laws, resulting in specific pollution of the local water supply by heedless disposal of excreta. The omnipresence of the colon bacillus shows to what a surprising extent the human animal, even in this enlightened age, defiles the localities in which he dwells,—the soil, the water and the food being contaminated so often that this condition may be regarded as usual and ordinary, and avenues for the dissemination of typhoid fever may therefore be considered to be always open. Defence against the spread of this disease lies almost wholly within the control of the individual himself, yet it is clearly shown by the circumstances under which the constant recurrence of this affection appears, that individual action cannot be depended upon to exercise the requisite degree of care in disposing of excreta, and safety against this affection therefore still lies, to a great extent, in official sanitary supervision. Built-up districts, having efficient sanitary departments, successfully provide for the speedy removal and disposal of waste materials, and for the exclusion of such materials from the public water supplies, but comparatively few people can be relied upon to protect the water of a domestic well against careless or accidental contamination, and we are brought to a reaffirmation of the statement that "no community is well defended against the spread of communicable disease until it becomes populous enough to be well organized." The reduction of the death-rate from typhoid fever has been chiefly affected by the improved sanitary conditions in towns, and the relations formerly existing between urban and rural districts, so far as the prevalence of this disease is concerned, are now reversed, the proportion of cases of typhoid fever occurring in scantily populated regions being much larger than in towns.

Physicians have for a century proclaimed the inestimable value of vaccination, and it has been conclusively shown that smallpox can be

prevented with almost absolute certainty by vaccination promptly performed and duly repeated, but while no very widespread or pronounced antagonism toward vaccination has appeared in this country, yet indifference to the protection afforded by the great discovery made by the immortal Jenner is almost universal.

The employment of aseptic precautions in the performance of this trifling operation, and the more careful selection of vaccine devoid of accidental impurities, has robbed the opponents of vaccination of all valid objections which have been urged against it, and no vestige of an excuse remains for refusal to acquire protection against a disease which not alone brings loathsome illness, death and domestic desolation in its train, but which, to a degree reached by few other affections in America, also causes untold damage to business interests, derangement of traffic and large municipal expenditures.

The year 1899 will be remembered in connection with the International Tuberculosis Congress in Berlin, assembled for comparison of views concerning the most effectual and available means for diminishing the loss of life occasioned by the most prevalent and fatal of all diseases. Says the Lancet: "International action in regard to diseases is more and more understood to be a necessity of civilization, and one of a kind to which national prejudices must give way, and we look forward to a time when international measures to prevent the dissemination of diseases will be among the most important features of civilized States." Considerations relating to distribution, etiology and prophylaxis occupied much of the time of this notable gathering, but little that was new was suggested concerning treatment,—suitable sanitoria and the employment of systematic hygienic measures being regarded as the most potent means for promoting recovery, while much more is to be expected from prevention. Further study of the methods by which the spread of tuberculosis may be restricted has also engaged much of the attention of local sanitary authorities during the past year, but no general agreement has yet been reached concerning the course to be pursued for the prevention of this disease. The sources of infection are so numerous and so varied, and the procedures which are essential to a thorough obliteration of all infectious material involve such enormous outlays of money that notwithstanding the possession of definite knowledge regarding many of the channels through which tuberculosis is conveyed, public sentiment cannot yet be depended upon to sustain the enforcement of regulations providing for the exclusion from the markets of all foods containing tubercle bacilli, nor the isolation of infected persons. It has been urged against the notification of phthisis that the patient has, long before the diagnosis is made, been expectorating vast quantities of the tubercle bacilli, and

that efforts to destroy the infectious material can at best be only partially successful, but aside from preventive measures which relate exclusively to the patient himself and to the safe disposal of the sputa, the spread of the disease can be controlled to a very great extent by sanitary measures which are designed to secure the cleansing, disinfection and ventilation of infected apartments.

Sanitary authorities have led the way for the removal of one of the chief predisposing causes of phthisis by securing, in some localities, the enactment and enforcement of laws and ordinances to prevent overcrowding and habitual rebreathing of vitiated aid by securing the construction of dwellings which shall be well lighted, well ventilated, well drained and proof against the entrance of ground air.

Conservative recommendations for checking the prevalence of tuberculosis include (1) inspection of all bovine animals, meat, dairy products and dairy premises; (2) destruction of diseased animals and prohibition of the sale of diseased meat and milk; (3) exclusion of diseased persons from markets, dairies and other premises where food is prepared or sold; (4) frequent and regular disinfection of public conveyances and places of public assembly; (5) disinfection of all infected apartments after death or removal of patients.

While it must be admitted that these precautionary measures are inadequate for the entire eradication of this disease, they constitute the minimum demanded by the mortality records, and the time cannot be distant when notification will, by common consent, be added to the list of measures employed to exterminate this disease, for unless the centers of infection are known, efforts for the restriction of tuberculosis cannot be adequately applied. There is no disagreement concerning the opinion that individual immunity is promoted by the maintenance of vigorous health, and while every one is, under present conditions, exposed to the infection of tuberculosis, many escape without contracting the disease, while others proceed to make good recoveries when the laws of personal hygiene are more closely adhered to. Escape from tuberculosis consequent upon the consumption of infected meat is not due, in all cases, to the destruction of the bacteria during the process of cooking, for the interior of roasted beef does not always reach a temperature destructive to the tubercle bacillus, often not even that of the coagulation of albumen, and credit for protection when tuberculous meat is eaten must be given to the good digestion which most adults enjoy. Abundant air space, ventilation, sunlight, absence from dust, good drainage and a clean and dry soil all favor protection against pulmonary consumption, and all of these conditions are largely under sanitary control.

It is exceedingly gratifying, inasmuch as for the present we must trust mainly to voluntary precautions, without compulsion, for the application of preventive measures, to observe that the education of the public is progressing rapidly in regard to the modes of infection in this disease. The projects to establish sanitoria in salubrious regions for the reception and treatment of cases of phthisis is gaining popularity, and cordial support to this proposal has been extended by the medical profession. To exchange the artificial conditions under which human beings dwell in towns where business in its various forms constitutes the predominant influence, for a life in a pure atmosphere, largely out of doors, where all of the daily occupations, diversions, and the food and clothing, are directly supervised by a medical adviser, is to offer re-enforcement to the natural immunity, and, in most cases, to substitute right living for a life full of hygienic errors.

Formerly adulteration of foods was, in the main, merely a commercial fraud, designed to cheapen an article by substituting in whole or in part, some inferior substance, but in recent years the addition of antiseptics has become a prominent feature in the preparation of foods, and this department of the business has assumed the dignity of an art, the aim being to enable the dealer to dispose of stale articles on the representation that they are fresh, and to save the expense of refrigeration. The agitation attending charges that preservatives have been added to certain foods supplied to the United States Army has created a new and personal interest in this subject. The manufacturer has heretofore generally adhered to the view that no objection attaches to the addition of any substance which will prevent food products from spoiling provided that the quantity of the preservative required does not add materially to the cost of the article, and provided that he receives from the chemist an assurance that the added substance is not poisonous. The consumer on the other hand has invariably demanded, so far as he has made his position known, that the food supply shall be wholly free from additions of any sort, and that the laws shall compel producers and dealers to depend upon heat and cold for preservative effects.

Recent reports show that the use of formaldehyde as a preservative of milk has become very general in certain districts, and unless this practice can be arrested the prediction may safely be made that an increase in the mortality of infants in these districts will be recorded, for it can be accepted as a general principle that quantities of farmaldehyde, boracic acid and salicylic acid which are capable of preventing or retarding fermentation and decomposition of foods will also prevent or retard the digestive processes, and interfere with nutrition and assimilation. It has also been pointed out that the addition of antiseptics

to food is an excess of liberty—a license—which the laws should deny to manufactures and dealers, whose only motive is to promote their financial interests, and that to this end legislation should be sought which will provide that every food preparation consisting of more than one ingredient, and which is offered for sale, shall bear a label distinctly specifying the composition of the article. As milk which is produced, stored, transported and delivered under cleanly conditions does not undergo decomposition within forty-eight hours, when the milk is kept below 60° F., there is ample time for distribution and no justification exists for the addition of chemicals, even if it could be shown that they are not injurious.

Among the sanitary questions which have in recent years attracted increased attention sewage disposal is entitled to prominent mention, the extension of bacterial methods of treatment of sewage in England having been rapid and satisfactory. In America this method of purification has made comparatively slow progress, notwithstanding the fact that to Massachusetts belongs the credit of having first successfully demonstrated the efficiency of this means of rendering waste liquids inocuous, but the principle of biologic treatment of sewage is now so generally accepted that the doctrine may be regarded as firmly established.

Local sanitary administration has progressed in the United States in a manner which leaves no doubt concerning the most important factor affecting its efficiency, the personal equation being recognized as the predominant influence, and in municipalities where it is the good fortune of the citizens to have the benefit of the service of an executive officer whose natural endowments and acquired information fit him for his duties, great strides have invariably been made toward preventing the continuance of conditions injurious to the public health. Where the sanitary supervision is entrusted to several persons jointly, constituting a board, it is almost invariably the rule that such bodies delegate to some one individual the performance of the duties with which, under the laws, they are mutually charged, and the functions which remain to be exercised at the sessions of the board consists in expressions of approval or disapproval concerning the propositions submitted and of the work done, much as a jury in a court of justice exercises its prerogative.

The sanitary officer, realizing his relation to the community which he is appointed to defend against preventable disease, finds much to compensate him in the successful performance of the work itself, and he enjoys a high degree of gratification in securing the abatement of nuisances, restriction of the spread of communicable diseases, prevention of the sale of unwholesome foods and in securing good drainage

and pure water, and one of the personal characteristics developed by this occupation is disinterestedness, for all of the work performed is elevating in its influences and is designed solely to promote the welfare of others.

But the usefulness of preventive measures against communicable diseases has not yet impressed the public mind to a degree which renders the work of the sanitary officer at all times pleasing, and not the least of the annoyances and the trials connected with his dealings with the public is the popular tendency to hold positive opinions concerning questions which are very imperfectly understood.

Until local sanitary authorities, particularly those in small municipalities and in rural districts, shall become more efficient than they are at present, the influence and assistance of State boards of health is not measurable. Municipal concerns become yearly more complex and the relations which they bear to one another become more numerous and more in need of adjustment. It is more difficult every succeeding year to obtain special local powers by legislative acts, and certain conditions affecting the public health must, of necessity, continue to be controlled by a central authority. In the better organized districts there is still but little uniformity in the application of the health laws and ordinances, and many communities are solving anew the problems which have already been worked out in other towns. The scope of the work of a State board of health varies in accordance with the sanitary progress already made in the commonwealth, and is also greatly modified by geographical, financial and numerous other conditions and considerations, but the following duties at least seem properly to appertain to the central sanitary organization of each of the great political divisions in the United States.

1. Classification, registration and tabulation of certificates of marriages, births and deaths.

2. Sanitary supervision over cars, boats and other vehicles in which persons or chattels are transported through the State.

3. Investigation of local outbreaks of disease.

4. Investigation of nuisances, needs for drainage and neglect of sanitary laws.

5. Investigation of the sanitary condition of school-houses, tenements, manufactories, workshops and public buildings, and also inquiries concerning conditions affecting the health of persons confined or employed in such building.

6. Investigations concerning the sources of sickness and mortality, the effects of locality, employment and circumstances on the public health.

7. Prevention of the spread of contagious diseases of animals.
8. Prevention of the sale of contaminated milk.
9. Receiving and recording reports of communicable diseases.
10. Supervision over the management of the State bacteriological laboratory.
11. The detection of the practice of adulterating foods.
12. The prevention of the sale of dangerous illuminants.
13. The prevention of the sale of impure or inert vaccine virus, antitoxine or other animal products used for remedial or prophylactic purposes.
14. The control of the establishment and extension of cemeteries.

The necessity for establishing in the United States a national department of public health, has been strengthened by recent events, the addition of tropical possessions having added new responsibilities to those already borne by the general government requiring investigations concerning the distribution and character of the preventable diseases occurring throughout the entire territory occupied by the nation. A department of health controlled, so far as its general course of investigations and executive action is concerned, by representatives from all of the States, is demanded by sanitarians almost without dissent. Let us hope that before the dawn of the new century Congress will have provided the necessary legislation, and that all questions relating to maritime quarantine and interstate restrictions during the prevalence of epidemics will be administered under the direction of a central representative body.

At best only a fragmentary and incomplete review of the sanitary progress of the year can be presented within the limits fixed for this occasion and I must content myself with thus alluding to a few of the facts indicating the degree of activity with which a large number of men of the highest scientific intelligence in every civilized country are engaged in working out the problems connected with the prevention of disease and the promotion of health. From the progress already made in the amelioration of human woes and from benefits bestowed upon the State by reason of sickness prevented and useful lives prolonged, hygiene has won a position of first importance, no less in war than in peace; in country and in city; among the rich and among the poor; in all climes and under all conditions in which human beings exist, and a retrospect of the sanitary advancement of recent times stimulates and encourages those who are now engaged in carrying on the work.

ADDRESS OF WELCOME ON BEHALF OF THE STATE.

By Hon. SAMUEL G. SMITH, of St. Paul, Minn.

Mr. President and Members of the American Public Health Association—I regret very much that His Excellency, the Governor, is unable to be present and extend to you a warm welcome and to express the sense of honor conferred upon the State of Minnesota in your coming here to hold your great annual convention in our midst. I am sorry that he is not here at this opening session, so that you might have the weight of his important personality and to hear his eloquent words. But I may assure you, that in behalf of this great commonwealth, that in no place where you have visited, east, west, north or south, will the value of your work and the importance of your personal services to the great cause of humanity and to the furtherance of our modern civilization be more appreciated than here. And it is fitting that you should be welcomed in behalf of the State because your services have been very important and have added very much to the State itself. You have by your investigations and those of your colleagues made possible great events of State that were not possible half a century ago. The step from the sanitation of a State to the sanitation of the camp is very easy and a natural one, and the armies of civilization owe to your labors and those of your colleagues very important possibilities in the carrying on of great campaigns. But more than that, by the discoveries in sanitation you have added at least half a century or a full decade to the term of human life, and when we consider the immense benefit done to humanity along the line of medical science, the benefit to economics from the standpoint of politics, it is one of the great debts that we owe to the advancement of our modern sciences. I may say, frankly, gentlemen, it seems to me that you are expensive; that you have many views and many plans that weigh heavily upon the taxpayer, but it will be in the interest of a broader view of what you have done to lengthen human life, and especially in your help to the poor and in the prevention of disease, that the economic debt is entirely upon the other side, and that where you have cost the State one dollar, you have saved the State fifty dollars, and it seems to me that this is a recognition which ought to be made in the matter of the advance that has come to us through your services. When we reflect that during the past quarter of a century important advances in sanitation have been made, through your efforts, and that the men of this

Association are leaders of the people, it is only right that we should expect you to carry your wisdom and disseminate it and make it common. We meet together in behalf of the new social spirit, manifested by the new thought of brotherhood, in a very practical and matter-of-fact way. We cannot afford to neglect disease when it visits the humble homes of the poor, because it is there that great danger lies, and in your investigations of sanitation, in your observations of the water supply, in your treatment of filth diseases, in your discussions of the prevention of contagion, you have rendered as an Association valuable and lasting services. Your recommendations in regard to quarantine, which have been carried out, have proven successful. The whole country, therefore, owes to you a debt of gratitude. Because of your useful services, I venture to bid you a hearty welcome to this Commonwealth. I am glad you h ve come here at this particular time because we are glad to welcome you to this great Mississippi Valley, the glorious garden of the world, and we hope that while you are here you will make investigations in regard to the Mississippi water, as I understand that is one of the purposes of this Association in meeting at this time. We are glad to welcome you also because of the influence we hope you will exert upon the public mind.

You will remember that in the very terse statement of Holy Writ, it is said of an ancient King that Asa in his sickness betook himself unto the Lord, not unto the physicians, and Asa slept with his fathers. (Laughter.) In our modern times we have a good many people who betake themselves not unto the physician, but to the Lord, and strange to say, these too sleep with their fathers. (Laughter.)

I venture to welcome you in behalf of the new thought that will avoid errors, ancient and modern. Let us hope that the time will come when every man and woman of sense will be willing to go both to the Lord and to the physician and live out a full, round, one hundred years by doing it. I think that is one of the messages that is needed in our modern times. But I must not detain you, for there are others here who are to give you a more immediate and warmer welcome than I am able to do.

Let me say, in welcoming this representative body, I welcome, not alone those from the various States of the Union, but those who came from across our borders. I am very glad indeed on behalf of the Commonwealth to extend a cordial welcome to those gentlemen who represent our sister republic of Mexico—a republic that has been bound to us in the bonds of friendship for half a century, and whose progress we regard with far-seeing eyes, even as we regard our own growth and pro-

gress, and your relation to this Association has been the closer and warmer because of the gradual growth which you gave it some years ago in your own Capital—Mexico.

I wish also to extend a warm welcome to those delegates who come representing the communities to the north of us, brethren of our own blood and speech, from Canada, and I would if I could upon this occasion, when the sad message has come to us from beyond seas of calls to British arms, emphasize the warmth of our friendship and say to you from Canada that we are learning in these last days a oneness, not alone of speech, but of our blood, our faith, and our mission in this world. (Applause.)

On behalf, therefore, of the great State of Minnesota, whose jeweled glories I could not portray, if I should choose, the wealth of whose granaries is bursting out at this time of the year with food for the whole earth, I welcome you in behalf of this great Commonwealth, and beg to assure you that the whole State hopes to profit from your deliberations. Trusting that your sessions will be not only pleasant, but full of wisdom and profit to us and to the nation, I thank you for having listened to me so attentively in uttering these few words. (Loud applause.)

ADDRESS OF WELCOME ON BEHALF OF THE CITY OF MINNEAPOLIS.

By Hon. JAMES GRAY, Mayor, Minneapolis, Minn.

Mr. President, Ladies and Gentlemen—I believe I am becoming acquainted with the members of the American Public Health Association, as I met some of them last evening around a bacteriological dinner, which all of the members enjoyed very much. It was a remarkable dinner in this regard, that although some eight or ten speakers discussed bacteria after dinner, not one of them alluded to the fact that in Germany they call them germs, in Paris parasites, and in Ireland microbes. (Laughter.) The bacteriological section of this Association was represented very ably last evening, and I presume this meeting is a general nucleus of the other species of parasites in the Association. (Laughter.) The addresses last evening gave us the impression that while you develop bacteria and cultures and other nauseous things, you take such delight in finding it difficult to know what to do with them so as to fit bacteria to disease and fit disease to bacteria. But this is not a simple problem, as they informed us. But in the relation of bacteria to the public health the effort of the scientist is always to fit the bacteria and the disease in such a way as to keep prevention a little ahead of the infection. The object of public health measures, as I take it, is to head off disease, and we do this not by isolated effort, but by a union of forces, and this union of forces is possible in a community such as we have in the cities of America only by educational efforts.

Now, I am a member of the Health Board of Minneapolis, and have been for a few months, and I already know what an indignity is thrust upon some people by fumigating their houses, how they feel about it. One of the most interesting visitations of the mayor of a city like this was from a lady who had been treated for smallpox at the public expense. She called on me, and I was not sure whether I was glad to see her or not, because I did not know how long she had been out. She was greatly angered with the authorities for having saved her life from smallpox, and she was really mad because her valuable raiment had been taken away and burned, and the last I knew and saw of her was that she was in an attitude of indignation, telling us that she proposed to sue the city for thousands of dollars for the value of her raiment. This is one of many examples that health officers have to contend with among people in our cities who will not take care of them-

selves. When you realize that in a city of any size the most cultured and refined people are obliged to live within the radius of a disease, picked up by the most careless, you can see how much more intimate than one can possibly realize are our inter-relations in a city like Minneapolis, and it requires not only the passage of laws, but more than that to bring about a sanitary condition in a city. It requires a good deal of education and attention, and it is by such meetings as this that you make an impression upon the public.

We are thankful that the American Public Health Association has come among us and to inform the public on these subjects. We are glad you have come to Minneapolis because it is the largest and healthiest city in the Northwest, and there is no city so healthy that would not prefer to be still higher up in the percentage column of public health. All cities strive by means of figures to show that they are the places to go and live a long time. Such statistics are not always reliable. Honest effort on the part of public health officers must certainly result in an honest addition to the health of a city. This is because you are not only eminent physicians, but purely scientific men, and the people of this city can therefore very well set aside an evening for the purpose of welcoming you to this community. Your work is vitally interesting to us, much more so than the work of politicians, of lawyers, or even of theologians. I thank you. (Applause.)

ADDRESS OF WELCOME ON BEHALF OF THE MEDICAL PROFESSION.

By H. B. SWEETSER, M. D., of Minneapolis, Minn.

Mr. President, and Members of the American Public Health Association—I feel it a great honor to have been asked to formally welcome to our city, in the name of the medical profession of Minneapolis, so distinguished a body intent on so noble a mission. No higher business may we engage in than the truly altruistic one of striving to advance the well being of the human family, and in no way is this more surely accomplished than by creating an environment most conducive to a perfect physical and physiological development. A sound mind is essential to a perfect life, but a sound mind is only possible in a sound body, and a sound body can come only under proper environments.

Now, civilization, specializing, as it does, the effort of the individual and making the units interdependent, has created the necessity of living, as it were, *en masse*, of crowding into towns and cities, of close contact and frequent inter-communications, and while, in this way, it has added vastly to our comforts and to our opportunities for living a higher life, yet it has, by this very reason, created also a long series of dangers which were unknown to our less civilized forefathers. History is replete with recitals of the most appalling plagues which have decimated, not cities or provinces or even nations, but whole continents, annihilating at once and totally, untold human energy and force, and that the millenium, in this respect, is still in the future. Witness the present plague in the East, which has already gained an entrance into Europe and which is even now knocking at our own doors, and, if less dramatic, yet scarcely less destructive, the innumerable localized epidemics of typhoid, diphtheria, yellow fever, and all of the other infectious and contagious diseases which we seem never to be able to get rid of. Count up the unhappiness, the misery, the invalidism and the deaths which have followed and still follow in the wake of even the least of these disastrous visitations, and then consider that they are the evils which this and kindred associations are striving to abate and avert, and we will begin to appreciate what this society stands for, and, appreciating this, we will thank these men and women for coming to us with their knowledge and their experience to show us a way to a longer life, a better health, and a greater happiness for our families and for ourselves.

The medical profession has always, in all ages, been foremost in the ranks of those who have endeavored to improve the physical welfare of man, and it is therefore proper, that we, the physicians of the Northwest, should be among the first to extend to you our welcome. I wish to say to you that we feel it a privilege and an honor to have this American Public Health Association, which is second to none in its aims and missions, hold its meetings in our city. I know that by your presence here we will gain much of specialized knowledge, and from personal contact with you we will absorb an enthusiasm in the direction of public health which shall redound to the benefit of our community.

During your stay with us we hope you will have not only a profitable time, but also a good time, and we shall endeavor to the best of our ability to so cater to your enjoyment that, when you leave, you shall carry with you so fond a remembrance of us that these days shall be to you large red letter days. Therefore, Mr. President, and Ladies and Gentlemen of the American Public Health Association, I bid you a most hearty, cordial and whole-souled welcome to our city. (Applause.)

ADDRESS.

By CYRUS NORTHROP, LL.D.,

President of the University of Minnesota.

Mr. President and Gentlemen—I have not seen your program, and I did not know how long this thing was going on. You have had two or three addresses of welcome delivered to you on behalf of the State and of the City of Minneapolis, consequently there is very little left for me to say.

You are a body of learned students; you have met here for the purpose of discussing questions affecting the public health, your object is beneficent, and I feel almost ashamed to consume a minute of the time of such a learned body as this in saying anything. I did not have the opportunity of attending the services last evening in the bacteriological department, but I wish to congratulate my friend, the Mayor, on having done so and having crammed himself for this occasion. (Laughter.) I am generally present at such places, when I am needed, but I was needed somewhere else last evening. I am very glad indeed to have heard the Mayor recite so well his first lesson in bacteriology. It has been said that the wise men came from the East and went back again (laughter), and I suppose you have mostly come from the East and are going back again. I have been in this city for the last fifteen years; I came from the East, and I am *not* going back again. (Laughter.) I hope to stay here until I die, and be buried in Minneapolis. It is a royal city, and Minnesota is a royal State, and if you are not receiving at the hands of the doctors and their confederates in this city a royal hospitality, it is something that never has happened to any convention that ever met here before. Everything that can be done, I am sure will be done to entertain you and to make your visit profitable. We appreciate the services you are rendering in the interest of public health. To lengthen human life, or to alleviate suffering, is a mission that any young man or woman might be proud of.

I am particularly glad to have you of the East come here and visit us. I hope all of you, before you leave the city, will visit the University and see what it is. It is not worthy intelligent and educated men to come so far and then go home without knowing about the civilization of the region they have visited.

A story is told of a gentleman from New York who went down to the State of Maine. He was talking to a farmer, and the farmer said, "New York seems a good ways off." "A good ways off from what?"

said the man. The farmer replied, "A good ways off from Maine." I suppose many of you think that Minneapolis is a good ways off from Maine, but, gentlemen, we of Minneapolis and of the Northwest generally have learned one fact which you of the East have never learned, and that is this: The distance from Maine to Minneapolis is not greater than the distance from Minneapolis to Maine. (Laughter.) It is just as easy, in other words, for men from the East to visit the West and find out the conditions that exist there, find out something of the currents of public feeling, to find out something about the great heart of patriotism that throbs through this whole Northwest, as it is for us to go down to New England and to the Coast and find out how you feel and what you are thinking about. It is a good thing that these conventions call you to meet at different places. Some of you travel great distances to attend these meetings, and it is a great blessing to the nation that such a migration for a time takes place, and that men gain new ideas in regard to the country in which they live. There are men living in New England who know a good deal about England and the Continent of Europe, but who are as ignorant of the United States of America west of Buffalo as if they had never studied geography or history. And that is the only way to make a nation what it ought to be, a unit in feeling, harmonious in sentiment, having common interests and having sympathies that run from ocean to ocean and from the North to the Gulf. Whenever a convention comes here I feel that it is in the interest of national unity and of strong patriotism, because the members of such a convention are learning something in regard to the country in which they live. When I tell you that fifty years ago this whole region, now occupied by the City of Minneapolis, was an Indian reservation; that this city with its two hundred thousand inhabitants, and its not disreputable buildings, has grown up in the space of fifty years and has railroads reaching from Manitoba to Vancouver, from Portland to Seattle and Tacoma, from San Francisco through to New Mexico, and Southern California, and five lines to Chicago, you can realize the rapid growth of this section of the country. On the other side of the River, on the bank is a University that is not yet thirty-five years old, hardly more than thirty. It has three thousand students in the course of a year, and connected with it are various colleges, libraries, apparatus, laboratories, etc., such as we are not ashamed to exhibit to you, no matter where you come from. When I say all this, you get some idea of the growth and progress of the Northwest. This is what we want you to know and to feel. I do not mention these things as a matter of rivalry, as a matter of jealousy, but as a common love for the good of this country. Our institutions of learn-

ing are growing better, with capacity to meet the educational wants of the regions in which they exist.

I may point also with pride to the medical profession of Minneapolis, to the services they have rendered and are rendering in these matters, and the efforts made in a public way to co-operate with you in carrying out the ideas which you represent. That you have come here is a source of joy to us. I extend to you a most hearty invitation to visit me at the University. If you cannot come as individuals, come as a collective body. Let us show you what we have in the way of educational facilities, in the way of institutions in Minnesota before you go East. Of course, we do not expect you to feel in regard to the Northwest as you would feel in regard to your own homes. Home is sweet anywhere. Wherever a man lives it is the sweetest place on earth. No matter how delightful it may be to witness the beauties of Southern California, the oranges and lemons, the apricots and prunes and blossoms, which he never sees in any other part of the country, every man who has health will leave that State and be glad to return to his old home where the frost and cold make half of the year a struggle between life and death. We want every man to love his home; we want every American to feel that his home is America, and that every inch of ground from the Atlantic to the Pacific is American soil, and over it flies the American flag, and that the men who rally around that flag and live under the Constitution of this country—North, East, South or West—are brethren. (Loud applause.) That is why I am glad to see you here.

I can add nothing to the excellent address of welcome delivered by Mr. Smith, and particularly with reference to what he said to the delegates from Canada and Mexico, but I venture to make those words especially apply to my American citizens, in order that they may come over and see the University before they leave Minneapolis. It will be worth your while. You will carry back with you in your memories something that will be pleasant for you to think of when you are at home, and I hope it will not interfere seriously with the success of the great work for which you have met.

As far as a welcome is concerned, it goes without saying that such eminent and highly respectable people as you are would be welcome anywhere, and if you are welcome anywhere, you are certainly welcome here. But be that as it may, I desire to join with the chorus in one loud and enthusiastic acclaim of welcome. (Loud applause.)

REPORT OF COMMITTEE ON THE ETIOLOGY OF YELLOW FEVER.

By Dr. H. B. HORLBECK, Chairman,

Health Officer, Charleston, South Carolina.

To the President and Members of the American Public Health Association: Gentlemen—The Committee of the American Public Health Association to whom has been entrusted the subject of the Etiology of Yellow Fever beg to make their report as follows:

They would recall to your memories, your action for the past two years in making an effort to have an organized and competent body equipped for experimental research, in finding and developing the causation of Yellow Fever. You took occasion in 1897 in Philadelphia and gave authority to your Committee to request and induce the President of the United States to use such measures as he might deem best, in recommending to Congress to have them authorize the equipping and sending competent bacteriologists to a Yellow Fever centre for such investigation.

Your proceedings at Ottawa, Canada, will show that this Committee obtained an audience with President McKinley on November 15, 1897, with the result that his Excellency recommended to Congress the appointment by the President of a Commission of four expert bacteriologists for investigating the specific origin of Yellow Fever.

A bill was introduced (H. R. 5175), by Hon. William Elliott, of South Carolina, making provision to carry out the recommendations of the President. No action was taken by Congress.

At your last meeting held at Ottawa, Canada, September 27-30, 1898, this Committee was re-appointed and asked to again call to the attention of President McKinley the great necessity of obtaining a thorough knowledge of the etiology of Yellow Fever and to ask him to request Congress to give authority for the appointment of such a commission as would proceed to work on this most important subject.

Your Committee, consisting of Dr. H. B. Horlbeck, Charleston, So. Ca.; Dr. G. M. Sternberg, Surgeon General U. S. A.; Dr. S. H. Durgin, Boston, Mass.; Dr. A. H. Doty, New York; Dr. C. P. Wilkinson, New Orleans; Mr. Josiah Hartzell, Canton, Ohio; Dr. J. Y. Porter, Jacksonville, Florida; together with the then President of the Association, Dr. Geo. H. Rohé, waited on President McKinley in Washington on November 21, 1898, and presented the following petition:

AMERICAN PUBLIC HEALTH ASSOCIATION,
WASHINGTON, D. C., November 21, 1898.

To His Excellency, William McKinley, President of the United States:

SIR—At a meeting of the American Public Health Association held at Ottawa, Canada, September 27-30, the following resolution was adopted:

Resolved, That the report of the Committee on the Etiology of Yellow Fever be accepted and printed in the Transactions, and the Committee be continued; and that a Committee of seven be appointed by the Chair to wait upon the President of the United States with a view of obtaining a Bacteriological Commission to go to Havana to study the cause and prevention of Yellow Fever.

Members of the Committee—H. B. Horlbeck, M. D., Charleston, So. Ca.; G. M. Sternberg, M. D., Surgeon General U. S. A.; C. P. Wilkinson, M. D., New Orleans, La.; S. H. Durgin, M. D., Boston, Mass.; Josiah Hartzell, Ph. D., Canton, Ohio; A. H. Doty, M. D., New York; J. Y. Porter, M. D., Jacksonville, Florida—Attest: C. O. Probst, Secretary. This Committee had the honor of appearing before you last November just one year ago to ask your kindly interest in a matter that then appeared to them a great necessity, with the following appeal:

"It is hardly necessary to call your attention to the serious results of the recent epidemic of Yellow Fever in the States of Louisiana, Mississippi and Alabama, but we may be permitted to mention the fact that the great epidemic of 1878 resulted in the loss of nearly 16,000 lives and that it has been estimated that the total loss to the country resulting from this epidemic was not less than $100,000,000.

If the disease had been introduced six weeks earlier the epidemic of the present year might easily have reached proportions equal to that of 1878, or of the widespread and disastrous epidemics of previous years, 1853, 1867, 1873. The American Public Health Association has a membership of nearly 1000, including the leading sanitary authorities and health officials of the United States, of Canada, and of Mexico. Since its organization in 1872 it has always taken a prominent part in encouraging scientific investigation to serve as a foundation for practical sanitation in disseminating a knowledge of the conditions which favor the extension of epidemic diseases and of the means of prevention; and in assuring necessary sanitary legislation. In our opinion the matter which we now ask you to consider is of great importance, and we respectfully request that you will bring it to the attention of the Congress of the United States at an early date, in such a manner as may seem to you to be the best. We transmit herewith a draft of a Bill, the enact-

ment of which would in our opinion accomplish the object in view. Very respectfully, H. B. Horlbeck, George M. Sternberg, S. H. Oliphant, Samuel H. Durgin, Josiah Hartzell, A. H. Doty.

You were kind enough to recommend in your annual message of December 6, 1897, to Congress that a commission of four expert bacteriologists be appointed for a systematic bacteriological investigation of the cause and prevention of Yellow Fever.

A Bill was prepared by this Committee fulfilling this recommendation and was introduced into Congress by the Hon. William Elliott, representing the First District of South Carolina, the bill known as (H. R. No. 5175), herewith appended, 55th Congress, 2nd Session, H. R. 5175. In the House of Representatives, December 16, 1897. Mr. Elliott introduced the following Bill, which was referred to the Committee on Interstate and Foreign Commerce, and ordered to be printed:

A Bill for the appointment of a Commission of experts for the purpose of making investigations relating to the cause and prevention of Yellow Fever:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled—That a Commission of Experts shall be appointed by the President for the purpose of making investigations relating to the cause and prevention of Yellow Fever.

Section 2. That this Commission shall consist of four expert bacteriologists, one to be detailed from among the medical officers of the army and one from among the medical officers of the navy; one from among the medical officers of the Marine Hospital Service, and one to be appointed from civil life.

Section 3. That the President shall name one of the members of the Commission as Chairman, who shall direct the work of the Commission, and report to him from time to time the results attained. The headquarters of the Commission shall be in Washington, District of Columbia, and one or more of the members shall be detailed to conduct investigations in the City of Havana, Cuba, or in some other locality where Yellow Fever prevails.

Section 4. That the medical officers of the army, the navy, and the Marine Hospital Service detailed as members of this Commission shall receive no compensation beyond their salaries; but during the time that they are necessarily absent from their proper stations in the performance of the duties imposed upon them by this Act their necessary living and traveling expenses shall be paid from the appropriation in this Act. The civilian member of the Commission shall receive in

addition to his necessary living and traveling expenses, six dollars per day during the time he is actually employed in prosecuting the investigation contemplated by this Act.

Section 5. That the sum of twenty thousand dollars is hereby appropriated for carrying out the provisions of this Act, and for the purchase of necessary instruments and material, for rent of a Laboratory in Havana, Cuba, or elsewhere, and for other incidental expenses.

This was referred by the House of Representatives to the Committee on Interstate and Foreign Commerce. It has not been enacted and has not become a law.

The American Public Health Association, composed of a membership, from the United States, the Dominion of Canada and the Republic of Mexico, realizing the importance of a more important knowledge of Yellow Fever, have asked this Committee to bring to your notice and attention the continued requirement for the creation of this Bacteriological Commission. Our statement and argument last year engaged your kindly interest. We beg of you to note that as we regarded the Commission of importance last year we now regard the necessity for this Commission of even more supreme requirement.

The result of the late war with Spain gives the present control of the islands of Cuba and Porto Rico to the United States. The island of Cuba is the main centre and hot bed of Yellow Fever. A number of millions of the inhabitants of the United States have been subject to the infection of Yellow Fever for six months every year in their homes.

Now with an army of occupation on the island from the United States and the many thousands who from business necessity will come to this island, the vital importance of obtaining a knowledge of the cause and prevention of this fatal malady well esteemed and named "The plague of the American continent," becomes an indispensable obligation.

We have had again during the summer of 1898 two of the Commonwealths of the United States ravaged by Yellow Fever. The history of the past two hundred years reveals the deaths of hundreds of thousands dying from this great plague.

The specific origin of the disease is claimed to have been found by Dr. Sanarelli, and investigations are being carried out in this direction in South America.

Surely with the life and well being of so many millions of the inhabitants of the United States involved the American Public Health Association feel that they may ask for and obtain your earnest efforts to have the cause and prevention of Yellow Fever studied, and discovered and developed so that the citizens and residents of the United

States and the islands of Cuba and Porto Rica may be freed from its fatal embrace.

This Committee is of the opinion that the bill presented to Congress last year does not necessarily meet the requirements of the present changed situation. Respectfully submitted,

H. B. HORLBECK, M. D., Chairman.

The President accorded your Committee a full hearing, and showed great interest and expressed himself as recognizing fully the importance of developing our knowledge as to Yellow Fever.

A second time he recommended to Congress that a commission be organized in his message December 6, 1898, as follows:

In my last annual message I recommended that Congress authorize the appointment of a commission for the purpose of making systematic investigation with reference to the cause and prevention of Yellow Fever. This matter has acquired an increased importance as a result of the military occupation of the island of Cuba and the commercial intercourse between this island and the United States, which we have every reason to expect. The sanitary problems connected with our new relations with the island of Cuba and the acquisition of Porto Rica, are no less important than those relating to finance, commerce and administration. It is my earnest desire that these problems may be considered by competent experts, and that everything may be done that the most recent advances in sanitary science can offer for the protection of the health of our soldiers in these islands, and of our citizens who are exposed to the dangers of infection from the importation of Yellow Fever. I therefore renew my recommendation that the authority of Congress may be given and a suitable appropriation be made to provide for a commission of experts to be appointed for the purpose indicated.

The bill formulated to carry out the wishes of the President, as above referred to, has not been acted on by Congress.

It must be said that the duties of Congress have been overwhelming in the consideration of the immense interests requiring their attention, the resultants of the war with the Kingdom of Spain. Your Committee have thus on two occasions visited Washington and on these occasions sought the assistance of the President of the United States.

Your Committee recognize the extreme and imperative importance of the duties assigned them. They have to the best of their ability carried out your wishes.

They are as willing to-day, as when first organized, to give their best efforts to furthering the study of the etiology of Yellow Fever, and although it would seem that the seed sown so far has fallen upon stony

ground, they will, should your judgment so indicate, continue their efforts before the President and the Congress of the United States.

Your Committee would call to your attention the fact that Yellow Fever has again visited the shores of the United States in the current year 1899. Yellow Fever has appeared in four great States, viz., Louisiana, Mississippi, Florida and Virginia.

For over four months the great city of New Orleans has been suffering from the effects of the presence of Yellow Fever and although fortunately the disease has been of a mild type it has resulted in the partial isolation of 300,000 people in that city by the neighboring States of the South. While there have not been many cases or deaths in Mississippi, it has been deemed necessary to establish quarantine regulations inter and intra state. There has been present a general epidemic of Yellow Fever in the city of Key West, Fla., for the past two or three months, over a thousand cases have occurred, and between 50 and 100 deaths, resulting in a rigid quarantine against the city of Key West.

On July 29th the whole Atlantic Coast of the United States was startled by the report that Yellow Fever was present at Hampton, Va., in the Soldiers' Home. Active quarantine had at once to be established and the utmost precautions taken, interfering with the great commercial interests of the country—and so year by year—we have Yellow Fever visiting the seaports and towns of the South Atlantic seaboard and Gulf States of the United States and so further, for 200 years, we have been having Yellow Fever visiting the cities and towns of the United States. One year in one locality and another year in another, having caused hundreds of thousands of lives and creating losses amounting to hundreds of millions of dollars, and all due as is universally believed to a specific micro-organism.

Surely it would seem that this great country could afford to create and organize a competent commission of Expert Bacteriologists to discover and study and develop the active cause of the existence of so terrible and far-reaching a plague.

As we realize and recognize these immense interests at stake we feel that no expenditure or outlay would be too great for the accomplishment of the knowledge necessary to take procedures to limit the ravages of so constant an enemy.

Whatever work has been accomplished by the distinguished Bacteriologists (who had given time and research in this direction) has only brought them to the threshold of the temple of knowledge.

The micro-organism is to be discovered and determined and its life habitat must be developed, and its relation to its unwilling host, the

human race, must be studied and recognized and methods found for its limitation and destruction.

At your last meeting held at Ottawa your standing Committe on the Etiology of Yellow Fever called to your attention the claims of a number of distinguished bacteriologists as to various specific organisms, and their relations as being the cause of Yellow Fever. The most important and prominent was indicated as being the Bacillus Icteroides, described by Professor Guiseppe Sanarelli, now of Bologna.

A very full description of the Bacillus was presented by your Committee and is now a matter of record in your proceedings.

In reviewing the work of the year, as to the specific origin of Yellow Fever we find that the greatest interest has been manifested in this Bacillus of Prof. Sanarelli, by a number of Bacteriologists engaged in this most absorbing work, viz., the positive determination of the bacillus of Yellow Fever.

So far back as September 10-17, 1898, Dr. Novy, Ann Arbor, Mich., in an address published in The Medical News, opposed absolutely the possibility of the Bacillus Icteroides being the specific cause of Yellow Fever, basing his views on an experiment made by himself, which consisted in exposing the Sanarelli bacillus to a temperature for three days below 10° C., with the result that this freezing had no effect on the organism, and as it was a well-known fact that Yellow Fever disappeared on the appearance of a frost, he argued that the Bacillus Icteroides could not be the cause of Yellow Fever.

In The Medical News, April 29, 1898, Dr. Walter Reed, Surgeon U. S. A., and Dr. James Carroll, U. S. A., "Venture to express the opinion that the bacillus icteroides is a variety of the hog cholera bacillus and that it should be considered only as a secondary invader in Yellow Fever," adducing many experiments in proof thereto.

Prof. Sanarelli, in an able paper or argument—Medical News, August 12, 1899—reviews the views as expressed by Drs. Novy and Reed and Carroll, and still claims his bacillus as the true specific cause of Yellow Fever. Doctor Sternberg, Surgeon General U. S. A., and one of the most distinguished of bateriologists of this country, expresses himself in Medical News August 19, 1899, as follows: "Finally I would say it appears to me at the present time that like the colon bacillus and bacillus X, the bacillus of Sanarelli is a pathogenic saprophyte which is present occasionally and accidentally in the blood and tissues of Yellow Fever patients, and that its etiological relations to this disease has not been established."

A commission consisting of Drs. E. Wasdin and H. D. Geddings, was sent to Havana in 1897-98 by the Marine Hospital Service of the United

States to study the cause of Yellow Fever. Under date July 10, 1899, they state that we found the following conclusions:

First. That the micro-organism discovered by Prof. Sanarelli and by him named bacillus icteroides, is the cause of Yellow Fever.

Second. That Yellow Fever is naturally infectious to certain animals that in some rodents local infection is very quickly followed by blood infection and that while in dogs and rabbits there is no evidence of this subsequent invasion of the blood, monkeys react to the infection the same as man.

Third. That infection takes place by way of the respiratory tract, the primary colonization in this tract giving rise to the earlier manifestations of the disease.

Fourth. That in many cases of the disease, probably a majority, the primary infection or colonization in the lungs is followed by a secondary infection, or a second colonization of this organism, in the blood of the patient. This secondary infection may be complicated by the coinstantaneous passage of other organisms into the blood, or this complication may arise during the last hours of life.

Fifth. That there is no evidence to support the theory advanced by Prof. Sanarelli that this disease is primarily a Septicœmia, inasmuch as cases do occur in which the bacillus icteroides cannot be found in the blood or organs in which it might be deposited therefrom.

Sixth. That there exists no casual relationship between the bacillus X of Sternberg and this highly infectious disease, and that this bacillus X is frequently found in the intestinal content of normal animals, and of man, as well as in the bronchial secretion.

Seventh. That so far as your commission is aware the bacillus icteroides has never been found in anybody other than one infected with Yellow Fever, and that whatever may be the cultural similarities between this and other micro-organisms, it is characterized by a specificity which is distinctive.

Eighth. That the bacillus icteroides is very susceptible to the influences injurious to bacterial life, and that its ready control by the processes of disinfection, chemical and mechanical, is assured.

Ninth. That the bacillus icteroides produces in vitro as well as in vita a toxen of the most marked potency, and that from our present knowledge there exists a reasonable possibility of the ultimate production of an anti-serum more potent than that of Professor Sanarelli.

We have thus widely divergent opinions as to the bacillus icteroides in its relation to Yellow Fever.

Surely there is great occasion for more knowledge.

How is this to be obtained?

In the opinion of your Committee by the organization of an able and full commission of bacteriologists fully equipped and provided with ample means, who shall be permanently located in one of the Yellow Fever infected cities—Havana, or Rio Janeiro, or Veracruz or Colon—to have them provided with a thoroughly appointed and well arranged Biological Laboratory, with a staff or corps large enough to procure morbid material from day to day, and who will be constantly occupied in studying such various forms of bacteria as are presented, large enough to take notes and make records—so large as to be able to at once verify their findings and not to be obliged to wait months and months before sending out the result of their work, but to be able to send monthly bulletins of what has been determined upon as landmarks and sure, certain, developed facts, so that others may be benefited.

Sufficient remuneration should be provided so that the highest talent and most accomplished bacteriologists may be induced to become a part of the commission. So far there is nothing proved to the acceptance of all competent to know. It is an immense field and one well worthy of our best endeavor.

ARRANGEMENT OF THE SANITARY STATIONS WHICH THE BOARD OF HEALTH PROPOSES TO ESTABLISH TO PREVENT THE PROPAGATION OF YELLOW FEVER.

By Dr. EDUARDO LICÉAGA,

President Superior Board of Health of Mexico, Mexico City.

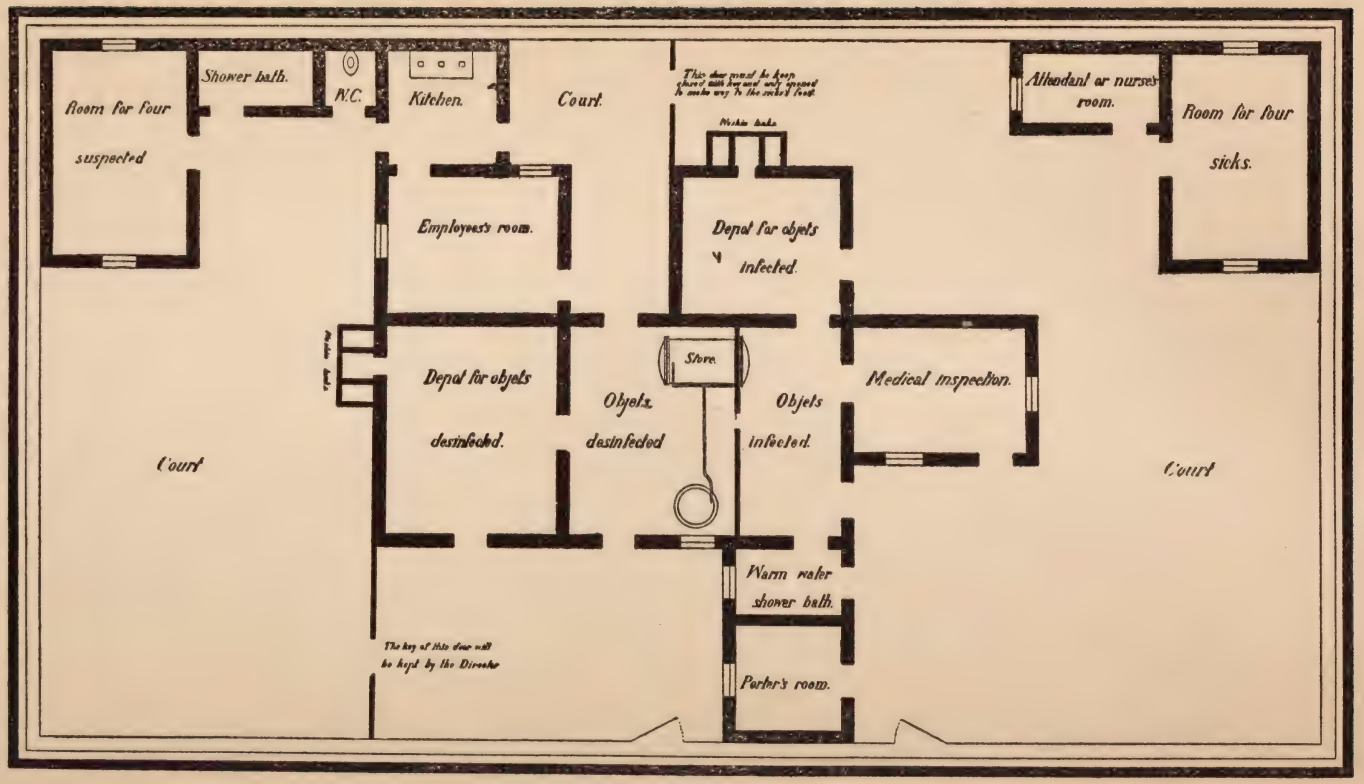
Each sanitary station will consist of the following: A room dedicated to medical examinations, which will communicate with another room for the reception of infected articles. Set into the partition wall between this room and the next is the door of the stove, and there is another door which communicates with the first room mentioned. On another side there is a door opening into a room in which are stored infected articles that require to be kept for a longer or shorter space of time on account of their quantity or of their not being immediately required. This third room has attached to it some washing tanks in which the soiled clothes are washed before passing through the stove, whilst the second room in which the articles are received has a bath room adjoining it that is provided with a warm water shower bath, for the cleansing and disinfection of all the persons who may come in contact with the passengers. To the right of these rooms but independent of them is a ward in which four patients can be lodged, with a separate room for the attendant or watchman. The porter's room is close to the entrance door.

This section includes that part of the sanitary station in which suspected or contaminated persons and articles are kept.

On the other side we have the following:

Next to the room for the reception of infected articles, there is a room which is separated from the former by a partition which reaches to the roof, having a window with a fixed frame that allows everything to be seen that goes on on the other side. In this room is the disinfecting stove with its boiler, and there the disinfected articles will be received. Another room of the proper size will be used for the storage of disinfected articles, and to this will be annexed a wash house for washing underclothing whenever required. Close to this room but with an independent entrance is another large room which is intended to be used as a dwelling for employes.

At the far end of the premises from the rooms dedicated to patients, a department will be built, consisting of a ward for suspected passen-


Room for four suspected
Shower bath.
W.C.
Kitchen.
Court
This door must be kept closed with key and only opened to make way to the sick's beds
Attendant or nurse's room.
Room for four sicks.
Employee's room.
Depot for objets infected.
Depot for objets desinfected.
Store.
Objets desinfected
Objets infected.
Medical inspection.
Court
Court
Warm water shower bath.
The key of this door will be kept by the Director
Porter's room.

gers, a room with shower bath, water closet and kitchen, of the proper size required by each sanitary station.

This section includes the whole of that side of the station which is dedicated to the baggage and articles already disinfected.

At the other extreme there should be a ward for the patients whose illness has been confirmed, and close by, a department for the nurses, which should be built on the same side as that in which the infected articles enter, but separated from it by a wall.

The two departments which form the station are separated by walls, so as to prevent all contagion passing from the infected articles to those which are not, and leaving only one door of communication between them for the service of the establishment, the key of which will be kept by the director.

The whole of the station will be protected by a fence; and the plan shows the arrangement of the grounds in yards, the purpose of which is to give ample ventilation to the whole establishment.

The staff for the service of the station will be as follows: Two hygienist physicians of great experience, a superior police employe, who will be specially instructed for the office, a machinist to work the disinfecting stove, a fireman and four servants. As far as possible this staff will be composed of persons who have already had an attack of Yellow Fever.

The inspection service will be carried out as follows: Every passenger who is brought to the establishment will be inspected in the proper room by one of the physicians, whilst the other notes in a special book the name, age, sex and destination of the passenger, with a memorandum of the state of his health. Whilst the physician makes the inspection a servant collects the clothes which the passengers are wearing, places them in a bag, which he closes with wire, and puts on a numbered check of which he gives a duplicate to the passenger so that he can obtain his clothes after disinfection.

Should the passenger be found to be in a good state of health the police officer issues him a certificate which will serve as a passport, and be delivered to the authorities of the place to which he goes, and afterwards fills up a blank notice with the name, age, sex and destination of the passenger, addressed to the municipal or political authorities so that the passenger may be kept under surveillance for seven days.

If amongst the passengers who are examined there should be a suspicious one, he will be passed to the proper ward so as to be kept under observation. Should he be already sick he will be isolated in the ward dedicated to that purpose.

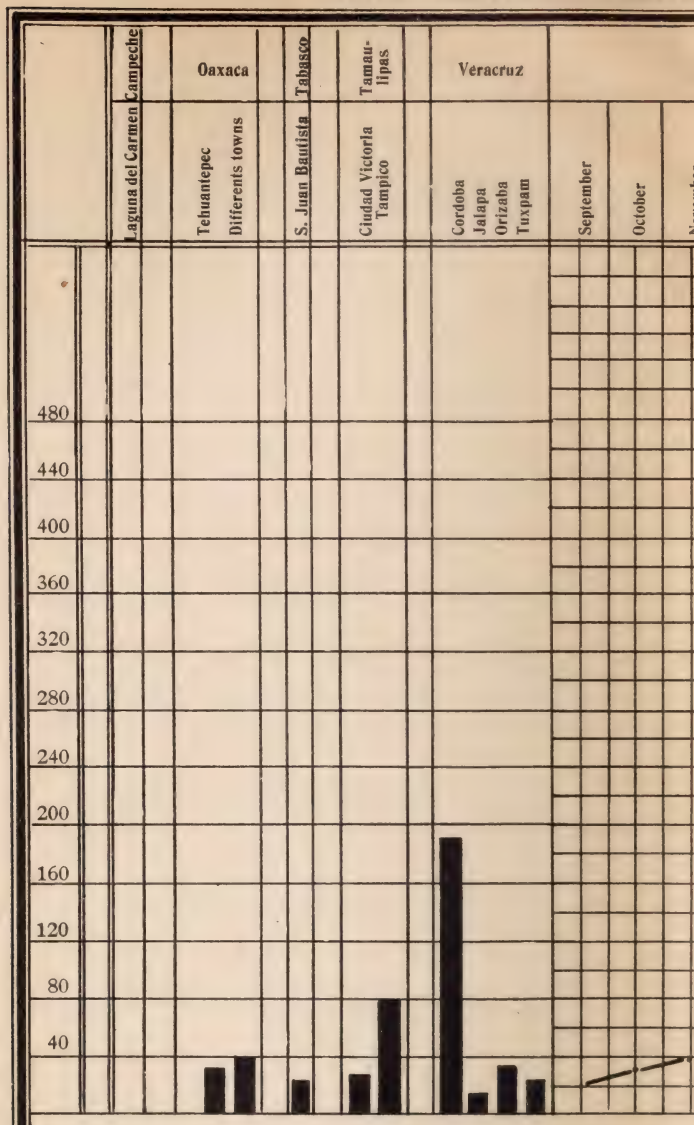
During the time employed in the medical inspection the man in charge of the stove will disinfect the soiled clothing of the passenger

and another servant will disinfect, by means of a solution of carbolic acid or other proper disinfectant, all articles of leather or other substance that cannot be passed through the stove.

The healthy passengers, having received their certificates, can go to the side of the stove where the disinfected articles are kept, and there claim their baggage on presentation of the duplicate check, and afterwards continue their journey.

TABLE SHOWING THE NUMBER OF CASES OF YELLOW F

INVADED FROM THE 13th OF SEPTE



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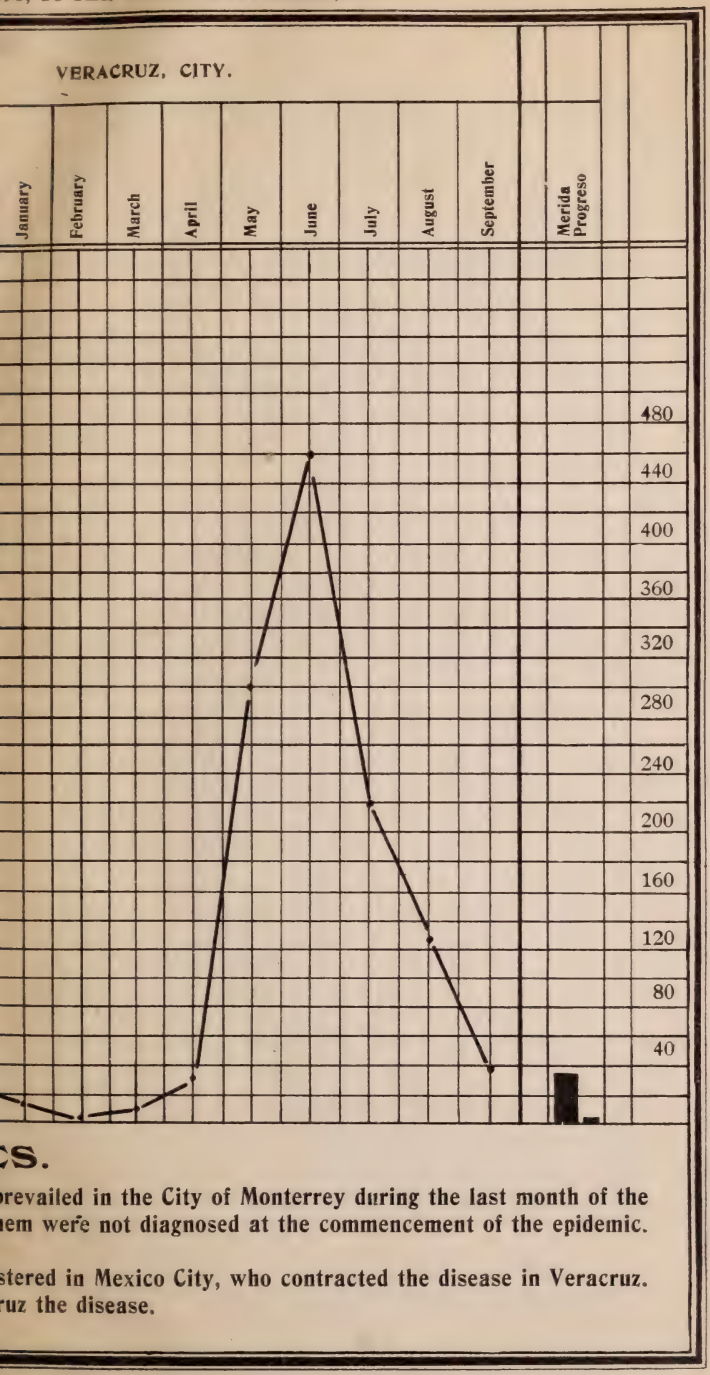
The number of cases that occurred in the epidemic
year 1898, can only be approximately calculated, because m
The number has been approximately calculated at 1,124 cas

In the curve for Veracruz, we include 2 cases that w
Equally, the 14 cases registered in Jalapa, who contracted

AT HAVE BEEN OBSERVED IN THE PLACES THAT HAVE BEEN
98, TO THE 15th OF SEPTEMBER, 1899.



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prevailed in the City of Monterrey during the last month of the
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stered in Mexico City, who contracted the disease in Veracruz.
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EIGHTH REPORT, PRESENTED TO THE COMMITTE ON YELLOW FEVER, OF THE CASES OBSERVED IN THE MEXICAN REPUBLIC, FROM THE DATE OF THE LAST REPORT UP TO THE 15TH OF SEPTEMBER, 1899.

By Dr. EDUARDO LICÉAGA,

President Superior Board of Health, Mexico.

I have imposed on myself the obligation of reporting every year to this Association, the data respecting the development of Yellow Fever in the Mexican Republic, and I now come forward to comply with this duty.

STATE OF TAMAULIPAS.

The first cases of Yellow Fever appeared in Tampico during the month of July, 1898. A careful investigation made by the delegate of the Supreme Board of Health in that port showed that the cases observed did not proceed from others which had been brought to Tampico by sea, but that they had been spontaneously generated within the town. These cases were found to have presented themselves almost simultaneously in different parts of the town, in persons who had in no way been in communication with the only two vessels which at that time had arrived in Tampico from infected points; one of them, the "Veracruz," without passengers or cargo, and the other, "Dorset," coming from Progreso, with five healthy passengers whose baggage had been properly disinfected in that port. Neither amongst these passengers nor among the persons who were in communication with them, did the disease in any way spread. As no passengers had arrived by land from any infected place, we have to accept the theory that the disease had spontaneously developed in Tampico, probably through the excessive rainfall during the rainy season, the great heat and other conditions that cannot be easily appreciated. I must remind my hearers that since the year 1878, when similar circumstances were found in Tampico, Yellow Fever had not made its appearance in that city, notwithstanding the fact that during that period of twenty years, passengers reached that port who had already contracted the disease, either in Havana or Veracruz.

From the 13th day of September of last year to the 15th of September last, the number of cases reported reached 82. If we take into account, that at that time there were about 3000 persons in Tampico who were not immunes, we must allow that it did not form a real epidemic.

The disease had only a limited power to spread, whilst on the other hand, the measures taken to prevent its propagation were successful. Besides the local physicians and the two delegates that the Board of Health has stationed there, two more were sent by this corporation with the title of Sanitary Agents; everything was done to isolate the patients; their clothes were disinfected and such as were of small value, destroyed by fire, the rooms occupied by the patients were disinfected, excepting in cases where the health officials failed to receive due notification. The poor were taken to the lazarette; the streets and squares were kept as clean as possible, and, in short, all the steps were taken that are required by the "instructions" forwarded by the Supreme Board of Health. The principal authorities of the state as well as the political and municipal authorities of the port, displayed special zeal in carrying out the hygienic measures which are necessary in these cases. From that date up to the 15th of September last, only three cases have been reported that were spontaneously generated within the town.

Yellow Fever was introduced in Monterey from Ciudad Victoria, where the disease had developed; amongst others, by a person who had already been attacked, boarded the train in Victoria with the object of going to his native city, Durango, and there getting the attention required. The car in which this person traveled to the Trevino Station was soon occupied, without previous disinfection, by another passenger who came from the North and was going to Monterey, and who on reaching the latter city felt sick, it being afterwards discovered that he was suffering from Yellow Fever. Other persons also came directly from Tampico, and spread the disease in the immediate neighborhood of the station. As the disease was then unknown in Monterey, the first cases were attributed to the remittent bilious fever which was prevalent in that city during the hot season.

At the request of the Governor of the State of Neuvo Leon, the Supreme Board of Health sent two physicians, of whom one was a specialist in pathological anatomy and the other in bacteriology. These physicians made a very careful study of the clinical aspect of the disease then spreading in Monterey, discussed their observations with other physicians who had attended cases of Yellow Fever on the coast or abroad, and were at once convinced that the clinical characteristics were those of Yellow Fever. Their opinion was confirmed by post-mortem examinations, one having dedicated himself to the pathological anatomy, the other to the bacteriological study of the disease. As soon as the information obtained was such as to carry conviction that the disease then prevalent in Monterey was undoubtedly Yellow Fever, they duly communicated that fact to the authorities.

The fact that the disease was not recognized by the local physicians can be very easily explained, seeing that they were not aware that it could spread in Monterey, and this is the reason why they did not take the necessary steps to isolate the first cases, and why the disease continued spreading during the months of October and November. These facts will also explain why it is that I cannot present an exact statement of the cases of Yellow Fever, whilst the report of deaths is perfectly exact.

Number of recognized cases.....1124
Number of deaths registered..... 281

Once the epidemic was declared, the political and municipal authorities as well as the medical profession, displayed the greatest zeal in preventing the spread of the epidemic, which eventually disappeared through the employment of the same means that had been employed in Tampico; and up to the moment of writing this report not a single case has presented itself.

STATE OF VERACRUZ.

The City of Veracruz has been very justly considered to be the most important focus of Yellow Fever on our Gulf Coast. From the date of my last report cases of this disease continued presenting themselves, and in the month of November they reached as high as forty-one, after which the number decreased progressively, until there were only ten cases in February. From that month, the number slowly increased in the month of March and beginning of April, and after that, it rapidly increased up to the middle of June, when it reached 460 cases. The decrease in the number of cases was just as rapid during the months of July and August, and in the first week of September it reached the minimum number of forty. All these statistics are taken from unquestionable data and are further illustrated by the diagram annexed to this report.

The easy and rapid communication which exists between the port of Veracruz and the City of Cordoba, resulted in the spread of the Yellow Fever epidemic to the latter city. On the appearance of the first cases, the Supreme Board of Health appointed a Sanitary Agent in Cordoba who by agreement with the local authorities and Board of Health, put in practice the same measures that had been adopted in other towns. The number of cases reported up to the 15th of September was 192.

In the City of Orizaba, which is also in the State of Veracruz, and had always been considered beyond the reach of Yellow Fever, the disease made its appearance for the first time during the month of August

of this year. In previous years the patients who came from Veracruz to Orizaba either died of the disease or recovered; but it was never propagated to the persons who surrounded them, for which reason it was considered that the town enjoyed immunity from Yellow Fever. This circumstance specially called the attention of the Supreme Board of Health as well as of the state and local authorities, and timely and rapid measures were taken, with the object of preventing the introduction of Yellow Fever patients from Veracruz or Cordoba, and also to confine the epidemic in the town itself.

The Supreme Board of Health has appointed a special agent in Orizaba; has ordered the transferring of passengers coming from Veracruz before they reach that town; orders have also been given for a strict medical inspection to be made of the passengers, for the disinfection of merchandise that could carry the germs as well as of the railroad cars; for a careful watch to be kept over the railroad employes. The Government of the State of Veracruz has been requested to establish a permanent sanitary station close to the City of Orizaba; measures have been issued to oblige all passengers coming by rail from Veracruz to pass through that station, and requiring them to take a bath and also to disinfect their clothes and baggage; suspected persons to be detained in an isolated place, separated from previous passengers and sick persons. In the City of Orizaba, vigorous measures have been recommended for the cleansing of the town, the isolation of patients, the disinfection of their clothes and dwellings, whilst those who cannot be isolated in their own houses or may not have the means of procuring the necessary attendance, should be taken to Lazarette.

Up to the 15th of September of this year, there were thirty-six cases in Orizaba, including those who had contracted Yellow Fever in Veracruz and carried it to that town, as well as those who contracted it in Orizaba itself.

In Tuxpam, which is also in the State of Veracruz, twenty-four cases have been reported up to the 15th of September.

Cases of Yellow Fever have also been observed in other towns of the State of Veracruz; but it cannot be said that the disease in those towns assumed the character of an epidemic.

In Tehuantepec, a town in the State of Oaxaca, thirty-six cases were observed up to the date given. A few isolated cases were also reported from other villages in that neighborhood and belonging to the same state.

In the State of Yucatan, Merida figures with thirty-eight cases and Progreso with four, up to the 15th of September. In the State of Tabasco only twenty-five cases were reported and in that of Campeche three cases.

The diagram annexed to this report shows at a single glance the total number of cases of Yellow Fever reported from the Mexican Gulf Coast; not a single one appeared on the Pacific Coast.

The above report places me under the necessity of making some corrections to the statements which I laid down in a positive manner in the Sixth Report, that I presented at the meeting which this Association held in Ottawa last year.

In the second of those statements, I said that the only foci of endemia of Yellow Fever which we had been able to observe on the Mexican Gulf Coast, were in Veracruz and in the Northwestern Districts of the Peninsula of Yucatan. The experience which I have since acquired compels me to state now that Yellow Fever is also spontaneously generated in Tampico, Tuxpam, Campeche and San Juan Bautista (State of Tabasco.)

The fifth statement I refer to was:

The zone in which the disease may appear extends along the whole littoral from the beach to an elevation of 1000 meters; we have no example of its going beyond that limit. The village of Las Animas, situated between the towns of Cordoba and Orizaba at an elevation of 1008 meters, is the highest point in which Yellow Fever has been observed——"

I regret to have to declare today that the limit of altitude at 1008 meters, which I laid down in the statement just quoted and in all my previous reports, has now been exceeded; that the City of Orizaba, at an elevation of 1287 meters above the sea level, has for the first time been invaded with Yellow Fever, which was during the months of August and September of the present year.

These two corrections which I make to my previous statements are of importance in connection with the precautionary measures to be taken against the spread of Yellow Fever, and are also of importance for those towns in the United States which find themselves in conditions similar to ours, as much from the point of view of the spontaneous generation of the disease in places that were considered immune, as from the point of view of their altitude above the sea level.

DISINFECTION IN YELLOW FEVER.

By Dr. N. del RIO, Veracruz, Mexico.

History demonstrates to us, with undeniable and concluding data, that the first cradle of Yellow Fever was the sea-boundary of the Mexican Gulf, principally, that part in the neighborhood of Veracruz, where many years before the arrival of the Spaniards, probably from the beginning of the actual geological period, the germs of that malady were produced and it maintained itself in an endemic state, the same as happens now, by the immigration of persons proceeding from the interior of the country. From here, the foci of the Antilles and Brazil got their origin, and here it has remained during so many years, being the principal obstacle to the progress of this rich portion of Mexican soil.

We must not wonder that nothing really useful has been done in that long period of time to exterminate this plague that causes so many ravages. Its nature being unknown, empiric measures without any foundation were employed to no avail; and although now we can not say that we know the real origin of the infirmity, nevertheless the important works undertaken, noteworthily those of Sanarelli, Wasding, Sternberg and Geddings, enable us to state that it is a microbial malady, it being sufficient for that statement to compare it with other sickness whose origin is well demonstrated as such, to find a perfect equality in their development and mode of being. This nature of Yellow Fever admitted, the necessity of measures to prevent its effects was forcibly visible, because one of the most glorious achievements of contemporary decimated, is the prophylaxis of contagious diseases, that heretofore decimated populations, and nowadays foresighted nations master and prevent their ravages.

In Mexico, the Superior Sanitary Board has long been trying to implant in the Republic the more scientific and efficient ways to better the hygiene of its towns, being principally intent in combating the Yellow Fever at Veracruz, principal focus of the enemy, using the great means now at our disposal to fight infectious diseases; isolation of the sick, and vigorous disinfection of other places and objects contaminated by them so as to localize and exterminate the illness in its first manifestations. But as the experience of many years has proved that in this region of the Mexican soil Yellow Fever appears spontaneously, the aforesaid board has represented to the Government the urgent necessity of proceeding to the sewerage of Veracruz and Tam-

pico, in order to attack the Yellow Fever germs in their cradle. This work is expensive and full of difficulties, for it is intended to transform the mode of living in those towns that during hundreds of years have created and kept within themselves the germs of Yellow Fever, and that have reached in those places their greatest degree of adaptation. The Superior Board of Health, and the Mexican Government undertake the work with faith in its results, being convinced that the ravages of Yellow Fever must give way before the exertions of Pasteur's century.

Mexican laws provide that the sick in towns infected with Yellow Fever be isolated by them and carefully disinfected; that the baggage of persons that leave such towns bound for other places in the Republic, or in a foreign country, must be disinfected before their leaving, and that the same proceeding be practiced with goods that are likely to convey infection. By this precaution it is meant to localize the malady, destroying the germ in its first manifestations and prevent its propagation outside of the place where it appeared. This law, recently promulgated, could only be applied for the first time at Veracruz during this year's epidemic, for five years transpired without there being a single case of Yellow Fever in that city. Of the effects obtained with these measures, we must first notice that for Havana alone there sailed from Veracruz in July and August, that is, in the full growth of the epidemic, more than a thousand persons; that their baggage was inspected by the port's sanitary delegation, and carefully disinfected, and that not one single case of transmission of the disease by those passengers or their baggage has been registered there, which fact has been made known to the Surgeon General of the Marine Hospital Service of the United States of America by Dr. Hodgson, who is delegated at this port, in his report of August the 15th, published the 1st of September. For national ports there left in the same time a larger number of persons, and neither has the epidemic been transmitted to any of those ports.

We had, instead, the development of Yellow Fever in Orizaba, doubtless carried from Veracruz. Confident in the immunity that the former city has ever enjoyed on account of its altitude of 1300 meters above the level of the sea, altitude never overreached by the Yellow Fever in Mexico, the railroad trains continued to go from Veracruz without any precaution being taken with respect to passengers, their baggage or the goods carried by them.

This railroad has been running for the last 28 years and it never had propagated the Yellow Fever, nor had this sickness been observed in Mexico in an elevation of more than a thousand feet above the level of the sea, by which is justified the confidence there was in taking no

precautions with persons and things proceeding from Veracruz. The first cases observed in Orizaba were in persons that worked in the railroad station or lived in its neighborhood.

These two examples are conclusive in demonstrating the power of disinfection, and also that this operation is practiced efficiently at Veracruz. Baggage and goods disinfected in that port have not carried the disease neither to Havana nor to the other ports of the Mexican coast; that is to say, to the localities really propitious for the development of its germs; on the contrary, the same matters, when not subjected to disinfection, transmitted the sickness to regions that to that day were thought not proper for the propagation of the yellow agent. It would seem that in the present year this agent has had a greater virulence than in former years, or that the natural conditions of Orizaba are now different from those of other epochs. The truth is that there arrived germs to originate the epidemic, and that these germs did not exist in the baggage or goods that went to Havana and Mexican ports, favorable for their development, inasmuch as they did not transmit the disease there.

The epidemic of Yellow Fever at Veracruz in 1883 was very severe and caused the greatest mortality known in that city during the last twenty years. It extended to the harbor and produced considerable ravages in the crews of the ships, for nearly all experienced the disease and many lost all their men, having to wait in port until a new crew came over in order to be able to return home. Then, the sick were not isolated nor were the habitations and objects subjected to contamination disinfected. In the present year also the sickness extended itself to the harbor, the first case being observed in the Spanish brigantine, "Dolores Romano," that had in two days seven sick out of her crew of fourteen men. The ill were separated and a complete and general disinfection of the vessel was practiced, and there was no other case on board, though the other men were not immune. The Spanish steamer "Mayo," sailing between Bilboa and England, came down to Veracruz with a coal cargo, and the captain, dreading the disease, forbade his men to come on shore; but he had twenty men from the city daily employed in the unloading of his vessel, and these men carried the contagion on board. The three engineers got sick and were immediately separated, being sent to the hospital, and the department they occupied in the ship was disinfected. Three days after, the cabin boy, that served the engineers and accompanied them to the hospital, got sick, being also separated. The captain was notified that it was necessary to practice general disinfection of the whole vessel, which was not accepted by him, who stated that he was ready to clear that day. In the bill of health, given to him by the delegation of the Board of

Health, these circumstances were noted, and as we find in the account of the Marine Hospitals of the United States, the steamer above named arrived at Ship Island, having had during the trip sickness on board. The English steamers "Mira," "Gladiolus" and "King Gruddfyd" had also some sick on board that were separated and the ships disinfected, there being on board no new cases, though the vessels went on traveling on our coast, and went afterwards to Havana. These were the only vessels infected during the epidemic of 1899, and as it had been seen, the sickness was immediately localized and was not transmitted to the other vessels lying in port, the contrary of what happened in the year 1883, in which the disease became general to nearly all the ships in the harbor, and it attacked in them the majority, and in some cases all of the crews. This comparison, which demonstrated the efficiency of isolation and disinfection, and the necessity that the latter be general and not limited to the invaded department, is very eloquent.

We have before stated that the yellow fever agent had a greater virulence in the present year than in other epidemics; and we must add that in nearly 26 years that we have been observing the Yellow Fever at Veracruz, we have seen some very severe epidemics, as those of the years 1881, 1883, 1885 and 1892, remarkably that of the year 1883. That was the one that produced the greatest mortality; but in the epidemic of 1899, nearly all of the diseased presented a very grave form, a super-acute development, for death in fatal cases occurred generally from the third to the fifth day. The incubation in many cases could be exactly determined, as nearly null, for persons that arrived in a steamer in full health, proceeding from healthy places, who took the railroad train on their way to the interior of the country, reached their destination already infected, getting the disease in their short transit through the city; other persons that on account of pressing affairs, had to go to Veracruz, remaining there but a few hours, returned to their homes with the illness, that appeared on the second or third day of their arrival at their residence. The same could be observed in the greatest number of the diseased in the course of the malady; the nervous derangements, the hemorrhages and the uremic symptoms presented themselves prematurely and with exceptional intensity; divers medicines that in other occasions had been effective on some predominant symptoms, were now completely powerless; and lastly the yellow fever germ could this year develop itself in Orizaba at a height of thirteen hundred feet above the level of the sea, that before was unreachable by Yellow Fever in the Mexican Republic.

Of this exceptional gravity one of the principal causes has been the poor hygienic condition of the town, in the most part owing to the works going on to better the port. Dikes have been built in the sea in

front of the town and the empty space that remained has been filled up with the sand drawn from the bottom and with the dredgings of the bay; and these dikes prevented the flow of dirty waters from the sewers, which waters stagnated in the streets and could not be well swept out on account of the want of current in the sewers. Besides the removal of that great quantity of sand from the neighborhood of the town to build dikes, as also that extracted from the bottom of the sea, there is another dangerous element that has been pointed out long ago in divers countries, and that in Veracruz must be the more dangerous on account of her soil being deeply infected, as the place where Yellow Fever has acquired the greatest adaptation, be it only for the centuries that have elapsed since the illness manifested itself there.

Following the natural progress that the Republic has achieved in these last years, Veracruz has increased its population, principally with persons from the interior of the country and with strangers, an increase very remarkable in the last ten years. We find, therefore, three very favorable conditions to make the epidemic of the year 1899 the most fatal of all epidemics observed at Veracruz—great virulence of the germ; worse hygienical conditions of the city, and greater agglomeration of persons not immune. Notwithstanding all this, a greater mortality was observed in the epidemic of the year 1881, and above all, in that of the year 1883. The former caused 723 deaths; the latter 747, and that of the year 1899, 579. In this last one nearly all the sick were isolated and the disinfection of the places occupied by them was practiced, also the disinfection of the objects they could contaminate.

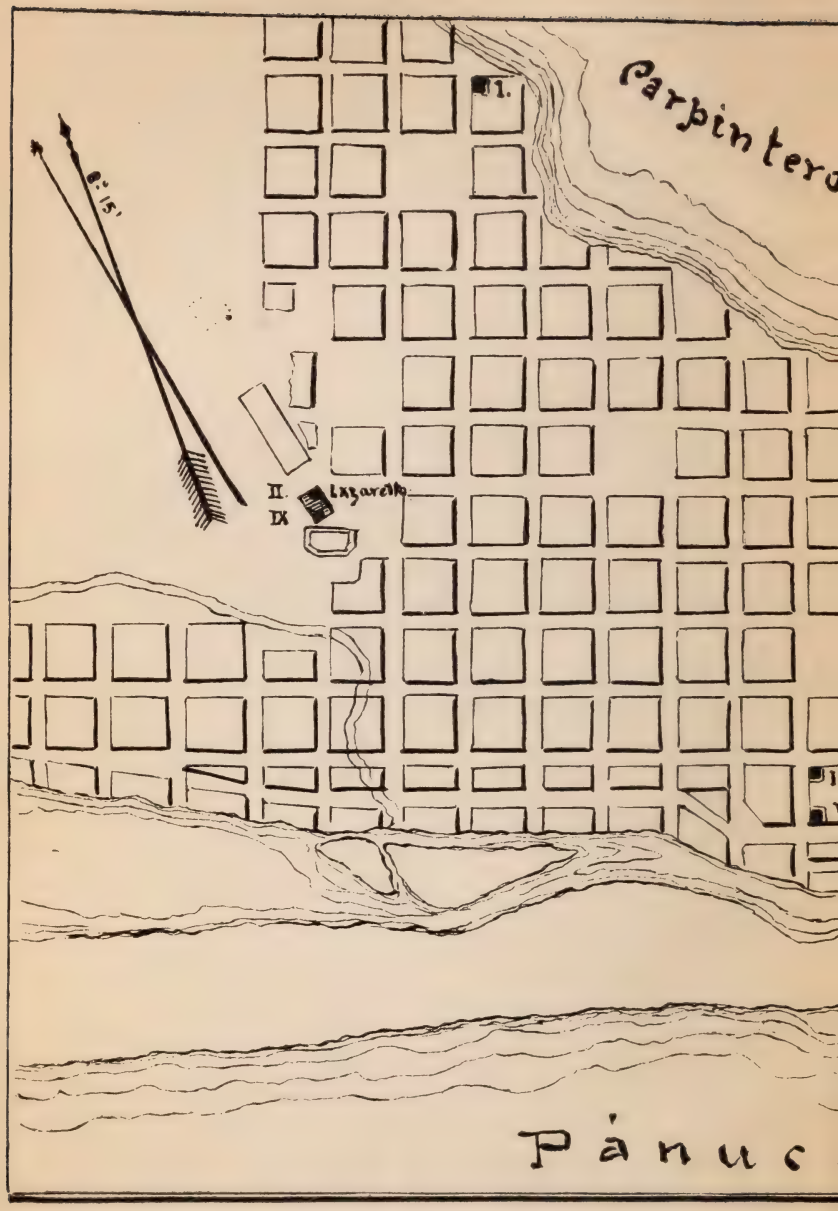
The Board of Health strongly insisted on having all the sick isolated and the disinfection of rooms and objects practiced, which measures were, however, not always applied with all the vigor that should be employed in their application. It is known that any method, for the first time implanted in a town, is deficient, and the more so in a town like Veracruz, familiarized with Yellow Fever, by the custom of observing it during so many years, as a sickness proper to the locality, for which reason the greatest number of the inhabitants do not consider it as communicable to the healthy man from the sick one. This occasions that isolation in many cases is not real, and that disinfection, in such cases, is not carried on as completely as it must always be in Yellow Fever. When a sickness presents itself epidemically in a town and may attack all its inhabitants, or at least the majority of them, the natural dread or the instinct of self-preservation obliges everybody to take certain precautions that definitely bring on a true isolation of the diseased; but when the greatest part of the inhabitants are immune to the epidemic, and are fully convinced that they may be exposed to it without danger, then the stated precautions are uncared for, some details

that seem to be trifles are forgotten, though in reality they are important, and the isolation of the sick can not be secured. In these conditions the authorities' vigilance is inefficient, as it always happens that the greatest part of the inhabitants do not help them in their purpose, for it would be necessary to put a vigilant official near every one of the patients, or send to the Lazarette all the sick, without any distinction, a thing as yet nearly impossible in a country not accustomed to those measures and that has to be educated slowly to those proceedings unknown till now. But just as we have admitted with entire loyalty that in many cases the isolation and disinfection practiced this year at Veracruz have been imperfect in their application, we must also say that those cases have not been the largest number, and that on the contrary, with the largest number they have been applied with the utmost vigor, being able to give assurance that if unluckily another epidemic should occur there, they could be applied to every case; for the population has acquired now the most convincing lesson, that one that comes from demonstrated facts.

With the experience of what has now happened, the Board of Health is trying to prevent the propagation of Yellow Fever from Veracruz to Orizaba being repeated. To this effect sanitary stations are being built on the railroads that go to the last named city, and the one from Veracruz to Jalapa. That being at the same level as Orizaba, is as likely to have the disease transmitted there by the trains. These stations will be reached before arriving to those towns, so that on the arrival of the trains from Veracruz, the baggage of passengers and goods susceptible to contamination may be disinfected. This finished, they will be transferred to another train, previously disinfected. An account will be taken of persons going to those cities, so that the authorities may keep watch on them for seven days, so that if anyone carries the sickness he may be immediately isolated and may not become the means of transmitting the illness. With these sanitary stations, and a real isolation for all the sick, and disinfection for every contaminated thing become general at Veracruz, the transmission of the sickness by the diseased, or by the contaminated places and objects will be largely prevented. But there yet remains the spontaneous development of the malady. Although the places where it can take place are daily restrained, owing to the thorough investigations that are made about the origin of an epidemic which have nearly always demonstrated that the germ has been imported, it is, however, certain that the spontaneous origin has been proved at Veracruz, where the most scrupulous investigations has not been able to find another cause. To remedy this, the Board of Health insists on the necessity of improving the healthfulness of our ports, and owing to its repre-

sentations the works to this end are about being commenced at Veracruz and Tampico. So that with the strict observance of the precautionary measures to prevent the transmission of the disease; with the improvement of the healthfulness of the ports, and the completion of the great works, that will soon be finished in the harbor of Veracruz, this city will be put in the best possible condition to defend itself against the Yellow Fever epidemics; and the town, that till now has been a dreadful focus of Yellow Fever, and therewith a dangerous neighbor to the other ports, will place itself, on account of its hygiene, on the level of the more advanced capitals. Such is the purpose of the Mexican Government, having in mind that the extinction of Yellow Fever as an endemic of the Mexican coasts, will be the most remarkable feature of the admirable progress being realized by the nation.

Lastly, we must make it remarkable as a proof of the loyalty and good faith with which Mexico deals with the other countries, that as soon as the first cases of Yellow Fever were observed at Veracruz, they were made known, the delegation in the port being ordered by the Superior Board of Health to note the bills of health that were given to vessels clearing from there, stating truthfully the number of cases and deaths which had occurred, information that was handed to Consuls in the above named office, as also to the newspapers and everybody that called asking for those data. The harm to be occasioned thus to the city and to trade was known, but before the rights of truth and the interests of health, every other convenience must be sacrificed and we always deal with loyalty and honesty. Such is the rule of behavior, of the Mexican Superior Board of Health.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Map of Tampico.
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IV. Spontaneous ... (.. fourth .. do ..)
V. ... do ... (.. fifth .. do ..)
VI. From Europam ... (.. sixth .. do ..)
VII. Spontaneous ... (.. seventh .. do ..)
VIII. do ... (.. eighth .. do ..)
IX. From Tantoyuca ... (.. ninth .. do ..)
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VIII.
VII.
VI.
River.

YELLOW FEVER IS A PREVENTABLE DISEASE.

By A. MATIENZO, M. D.,

Health Officer at Tampico, Mexico.

When Pasteur's genius substituted for the agent miasma, indefinite and mysterious, the agent germ, precise and tactile, an immense horizon was opened to the etiological study of diseases, enveloped till then in a thick and fathomless mass, and there was then founded on an imperishable basis prophylactic hygiene.

You all know, as hygienists, the admirable results of his discovery, this fountain of good and origin of preventive medicine, which shows us the biological properties, habitat, morphology and physical and chemic influences, affecting or destroying the germs vitality and which attenuate or exalt their pathological properties; shows us—as one of many examples—that the organism of typhoid fever inhabits the patient's intestine, that it appears in his evacuations and is often communicated through drinking water; that it is lodged and lives in the ground, sewers and flooring, where, insensible at low temperatures, frost even, it keeps during a long time its virulence.

On showing us the biological proprieties of beings infinitely small and the causes affecting their vitality, he placed within reach powerful elements to check their effects; and he shows also that in every infection, besides the agent germ, is the agent soil, and that in bringing all our efforts to the destruction of the first by isolation and disinfection, we ought, also, with no less eagerness, to invigorate the second, rendering it refractory with all the means that modern hygiene has put at hand. And Yellow Fever, an endemic disease in the Mexican Gulf's littoral, hinderance to the commercial progress of our best ports, sword of Damocles suspended over the foreigner landing on our shores, is already subdued and gives way before hygiene, and as the great epidemic disease is no more an inexorable ill, becoming a preventable disease.

Tampico, geographically lying on the North extreme of the Torrid Zone, 22° 14′ 4″ latitude North; 1° 13′ 51″ longitude East of Mexico City, between the Equatorial therminal lines and isothermal 25°; topographically at the level of the sea, on the shores of Páuco and Tamesín Rivers, and on the base of Carpintero Lagoon; by its meteoric conditions, 32° 2′ maximum average in the hot months of summer, and by its excessive atmospheric moisture, combines all the climatic conditions required for the genesis and increase of the micro-organism of Yellow

Fever. Nevertheless, observations made for many years of late have shown that this disease is not endemic; and if it is a fact, that in such periods as 1863, 1878, 1879, 1898 the icteroide micro-organism found the telluric or atmospheric factors favoring its autochthonal increase, it is also true that very extensive epochs have passed away—20 years—without there having been observed one single case of Yellow Fever infection.

If the indispensable conditions for the genesis of the micro-organism are very seldom seen joined together, the sanitary measures recently instituted have rendered them less feared to-day. In proof of this assertion, and standing in contrast, may be noted on one side, the enormous morbidity and mortality of epidemics in 1878-1879, and on the other, the short permanency and slight lethality in 1898, in a city twice larger in extent and density of population. The following cases which I think should not be omitted, prove the prophylactic power of isolation and disinfection in Yellow Fever:

Case 1. E. Espinosa, a woman, 13 years old, born in Rio Verde, and residing in Tampico during some years, was taken sick April 7th last. Symptomatic table: Chills, headache and pains in the back; high fever the first days, remission after; frequent vomits and pains in the epigastric region; jaundice, and albuminuria later on; hemorrhagic gums, restlessness, anuria and characteristic black vomits. Died on the early morning of the 11th, and on making the autopsy I found the following anatomic lesions: Icterous post-mortem, liver of a dry leaf color, of normal size and on cutting, the textures in state of advanced fatty degeneration; hemorrhagic points on the mucous membrane of the stomach, and in the cavity a black liquid with grainy sediment, such as *"coffee grounds";* spleen of a normal size, showing degeneration when cut; hyperemia of the kidneys; urine scarce in the bladder, very albuminous. Clinic and anatomic diagnostic: Yellow Fever. Origin of the disease: Considering the place where the patient lived, in the extreme north of the city; her employment (bread seller) without any possible relation with the ships coming to the port which could originate an indirect contagion, proceeding some of them from Veracruz, where during some months there has been a Yellow Fever epidemic, this case, the first observed this year, is to be considered as sporadic and without doubt of autochthonal origin. Sanitary measures: Isolation of the attendants and members of the family, near the patient, and of all the inhabitants of the same block during seven days; incineration of the personal and bed clothing used by the patient and disinfection of the hut with sulphur fumes, and washing the walls and floors with corrosive sublimate at 2 per 1000.

CASE 2. L. Ollavide, a man, 15 years old, just arrived at Tampico, employed at El Paso as servant; he entered the Civil Hospital the 5th of June last. Symptomatic table: Chills, cephalalgy and pains in the back; high fever the first days, remission at the fourth day; injected and icterical conjunctives at the base; frequent vomits of the food and liquor he takes; pains in the epigastric region; urine very albuminous, febrile remission, injected gums. After the 8th the albumen in the urine disappears and the patient goes out cured the 14th. Clinic diagnostic: Yellow Fever. Sanitary measures: Isolation of the patient in the city Lazarette; disinfection of clothing with corrosive sublimate 2 per 1000, and antiseptia of the room, where the patient was, with sulphur fumes; washing of floors and walls with hydrocresol solution 5 per 100. Origin of the disease: Sporadic and spontaneous.

CASE 3. M. Nava, a man, 16 years old, of Mexico City; ship's boy on the sailing ship "Yucatan"; arrived at Tampico from Veracruz; he entered the city Lazarette the night of the 30th of June, very ill. The day of his arrival, was attended after seven days at sea; he got the disease on passing through Veracruz. Symptomatic table: Chills, headache and pains in the back; high fever from the first day; apyrexia the last day; very hemorrhagic gums; injected conjunctives and lightly icterical in the base; vomits and tenderness in the epigastric region; urine very albuminous. Before death, convulsive state, restlessness and characteristic vomits of *"coffee grounds"*; died the 1st of July. Clinic diagnostic. Yellow Fever of sideral form. Origin of the case: Imported from Veracruz. Sanitary measures: Through the experience I had in the last epidemic, confident of the efficacy of isolation and disinfection. On knowing that on board the ship at anchor in the river there was a case of Yellow Fever, I ordered them to take the patient from the ship, and to isolate him in the city Lazarette. I feared, on the contrary, that his remaining on board would most likely be the cause of creating an epidemic focus of very serious consequences, as the greater part of the crew were recruits of the highland not enjoying immunity, and the sanitary conditions of the ship were not at all satisfactory. The closet, infirmary and crew's quarters were disinfected, with antiseptia of the bunk and clothes; during seven days the men that took the patient to the place of isolation were kept under observation.

CASE 4. A. Rodriguez, a Spaniard, 23 years old; has resided a year in Mexico, and has been in Tampico about a month, coming directly by the Central Railroad. Symptomatic table: At the beginning of the disease, the 7th of September, 1899, chills, high fever, headache and pains in the back; frequent vomits and epigastric sensibility; swollen gums, injected conjunctives the first days and icterical the third day;

pulse descending with temperature; urine albuminous; from the second day erithema and hemorrhagic exudations; melœnas and characteristic black vomits; died the 16th. Autopsy: Characteristic rigidity and icteric post-mortem; liver of a yellow color of chamois leather and in a state of fatty degeneration; spleen of normal size, altered textures; congestionated kidneys with degenerated spots; the stomach with hemorrhages in the mucous membrane and *"coffee grounds"*; same alterations in the intestine; urine in the bladder scarce with a great quantity of albumen. Clinic and anatomic diagnostic: Yellow Fever, of autochthonal origin, being the only case observed in the city since June last, for its origin direct from Mexico City, and the central part of town, where he lived. Sanitary measures: Isolation of patient in the city Lazarette and disinfection of the room with sulphur fumes, sublimate and lime water.

Case 5. N., a woman, 25 years old, America. Had lived in Tampico three years; during the last epidemic she lived in a ranch on the Tamesí River. When taken sick, she lived in a house where last year there were two cases of Yellow Fever; one of the sick died and the other recovered. The room occupied by the one who died was disinfected, not so the other, this one being the very room occupied by the patient subject of this observation. Symptomatic table: At the beginning of the disease, the 15th of September, 1899, chills, headache and pains in the back; high fever the first days, remission after, injected and icterical conjunctives; mucous vomits and pains in the epigastric region; albuminuria, and before dying characteristic black vomits; died the 22nd of September. Clinic diagnostic: Yellow Fever. Origin: Sporadic and spontaneous case with the circumstances of inhabitating a house of a very rudimentary hygienic conditions, where there had been cases of Yellow Fever without antiseptia of the room occupied by the patient. Sanitary measures: Isolation of the patient in the same room, evacuating the rest of tenants all around; disinfection during the sickness of dirty clothing, with sublimate, of evacuations and closet with copper sulphate and lime water; antiseptia of the room after death of patient with formaldehyde; incineration of bed clothing and washing of the floors with sublimate; the house shut up until whitewashing of walls and painting of ceilings, doors and windows was made.

Case 7. N. de Vasquez, a woman of 71 years of age; living in Tampico few months ago, coming from Guadalajara. Symptoms table: At the beginning of disease on the 22d, fever, cephalalgy, continuous vomitings and pain in the stomach; afterwards, fever's remission, icterical hue in the eyes and albumen in the urine on a large scale;

restlessness, red tongue at the point and coarse on the base, gums swelling without bleeding. On the seventh day, albumen in the urine disappears and fever ceased. Recovery. Diagnostics: Yellow Fever of small intensity. Origin: autochthonal. She dwells in a central building where, during the last epidemic, two persons died of Yellow Fever without disinfecting measures used afterwards. Prophylactic measures: Patient isolated in the same room. Antiseptia of clothes, water closets and furniture.

Case 8. A French woman, of 30 years of age; she has lived in Tampico since February of this year; she began to be sick on the 24th of September and died on the 1st of October. Symptoms table: Chills, headache and pain in the back; high fever, food and drinks vomited, and mucous afterwards. On the first and second days, eyes very injected, jaundice afterwards. Gums swelling and bleeding; red tongue on the borders; fever remission on the fifth day, and albumen in the urine in a very remarkable proportion. Delirium and uneasiness; epigastric tenderness. She had a black stool. Convulsions before dying. Diagnostics: Yellow Fever. Origin: Spontaneous. She was dwelling, the same as cases 5 and 7, in a central house in very poor hygienic condition and where two persons died of Yellow Fever in the last epidemic, without being disinfected afterwards, the said house. It is to be remarked that the patient was living in the same room where one of the patients died. Sanitary measures: Patient isolated in his room, antiseptia of clothes and stools; very careful antiseptia of the water closets belonging to the house of the seventh case's patient; room disinfected with sulphur vapors and sublimate; bed clothes burnt, and the house shut up until its sanitary conditions were satisfactory.

Case 9. A. de la Cruz, a man, 25 years old; arrived here the 12th of October as a recruit for the army; he comes from Tantoyuca, where there are some cases of Yellow Fever. Symptomatic table: Chills, headache and pains in the back, high fever the first day, remission after; frequent vomits and epigastric tenderness, jaundice, albuminuria; injected and hemorrhagic gums; the tongue red at the point and covered at the base; restlessness and ataxy in the afternoon of his arrival, the seventh day of sickness; before death, convulsions of the arms and characteristic melœna. Died the 13th. Autopsy: Yellow color; liver with typical alterations and color; the stomach congested, does not contain any blood; in the intestine a great quantity of *"coffee grounds"*; characteristic; bladder with little urine and albuminous. Clinic and anatomic diagnostic: Yellow Fever. Origin: Imported from Tantoyuca. Sanitary measures: Isolation in the city Lazarette;

isolation and vigilance during seven days of the other 13 recruits arrived with the patient.

In short, from the 10th of April to the 13th of October, 1899, nine cases of Yellow Fever have been observed in Tampico, three of them imported from Veracruz, Tuxpam and Tantoyuca, and the other six of spontaneous origin; three of those last six were originated in rooms that during the last epidemic were occupied by Yellow Fever patients.

Table showing the date, name, origin and prophylactic measures of the nine cases of Yellow Fever developed at Tampico:

DATE	NAMES	ORIGIN OF THE DISEASE	PROPHYLACTIC MEASURES	RESULT
10th Apr.	T. Espinosa	Spontaneous	Isolation and disinfection	Caused no contagion
5th June	O. Ollavide	do	do	do
30th do	N. Nava	From Veracruz	do (no quarantine	do
7th Sept.	A. Rodriguez	Spontaneous	Isolation and disinfection	do
15th do	N. N.	do	do	do
18th do	I. Andrade	From Tuxpam	do (no quarantine)	do
22nd do	N. Vazques	Spontaneous	Isolation and disinfection	do
1st Oct.	N. N.	do	do	do
10th do	A. Cruz	From Tantoyuca	do (no quarantine)	do

The sanitary measures established by the Mexican Board of Health, in force in all the Mexican ports, and the efficacy of which has been proved once more, smothering at their birth the first manifestations of a very transmissible disease, are isolation and disinfection, *abolishing land and maratime quarantines,* because of their doubtful efficiency and difficult practice.

In our sanitary maritime regulations, there is provided that when a ship infected with Yellow Fever arrives at port with sickness on board, or that has had cases during the last seven days of navigation, she will be submitted to the following regulations: 1st. Transportation of sick to Lazarette or other place of isolation. 2nd. Disinfection of the ship, or part of same contaminated by the sick. 3rd. Disinfection of passengers, baggage and susceptible goods. 4th. Landing of passengers in good health, which immediately should be taken to a place situated at over 1000 meters above sea level, or will be subjected during seven days to the vigilance of local authorities, and to that effect the health

officer will advise them of the arrival of such passengers. 5th. Disinfection of the ship's hold and renovation of drinking water. 6th. Interdiction of landing the crew. 7th. As soon as the preceding prescriptions are fulfilled *and without any other delay* but that absolutely necessary for disinfection, the ship is at free practique.

CONCLUSIONS.

First. The Yellow Fever, as the smallpox, scarlet fever, diphtheria, and in general all transmissible diseases, is a preventable disease.

Second. The isolation and disinfection practiced with all due care and necessary scientific knowledge, with general hygienic measures, such as proper water piping of drinking water, drainage of undersoil, arrangement of sewers, draining and drying of lakes and marshes and guard against swells of rivers, all of them to be soon realized, are the prophylactic hygiene of Yellow Fever.

INFLUENCE OF FORESTS ON THE PUBLIC HEALTH.

By Dr. JUAN BREÑA, Zacatecas, Mexico.

"Protect your forests and thereby you may protect yourselves."
—Ebermayer.

It is so universally recognized today that the proximity of forests is favorable in different ways to collections of human beings, that any discussion on this head would be useless, and, at starting, we may accept this fact as a point gained.

For the special object of this paper it will be sufficient, in my opinion, to enumerate the chief circumstances which give rise to the beneficent influence exercised by woods on health and the preservation of our species. Before considering certain propositions which now, as formerly, are accepted, *nemine discrepants*, as the direct result of sound observation, I will say two words of others which, after having been counted amongst the most universal popular traditions, have been questioned and even disputed of late years by those who have devoted their time to climatic studies.

Perhaps the most firmly rooted of these beliefs has been the one which admits that the quantity of rain over a given surface of ground is in direct relation to the number of trees sustained by that piece of ground. It has also been affirmed that the gaseous changes which have been effected through the foliage modify to a marked degree the composition of the atmospheric air by increasing the proportion of oxygen and diminishing that of carbonic acid. The former of these assertions, namely, the one which allows a direct action of the abundance of rain on the growth of the woods, has given rise at no distant date from the present (1889) to interesting debates between various American and German scientists. There has even been one to state that the thing mentioned is absolutely erroneous, like so many other false interpretations of natural phenomena, which often confuse cause with effect.

In spite of this, Gunther, Ebermayer, Blandford, and, with them, other English observers, by deductions obtained from numerous experiments made in the East Indies, stick to the traditional conviction and sustain that it will receive the most complete scientific confirmation in the future. They state that they base their judgment on the surprising peculiarities found in some specimens of the tropical flora in the Canary Islands. Amongst the former, descriptions have been given of "rain trees," or "weeping trees" (*casalpina pluviosa*), etc.,

which, after the fashion of a shower-bath, shed around them the steam of the water which they condense, and, amongst the latter, there is a kind of tree which waters the ground lying beneath its shade with the water which it absorbs from the sea-air.

The patient and careful experiments made by Fauteat in studying the comparative power of condensation possessed by the different trees of the forests of Europe of the vapors of the water existing in the atmosphere, have lead to results of interest on account of their great value and most useful practical significance. Brandis and Studnika also have upheld in their writings the truth of the old theory, it being remarkable that even the most pronounced opponents of that theory, like H. Gannett, have not gone so far as to deny altogether the influence of the flourishing state of the woods on the fertility of the land.

They willingly admit that cultivated soil retains moisture better than uncultivated, and that forests may be looked upon as receptacles of water in that they resist sudden variations of temperature and moderate the violence of the wind.

The observer whom we have just mentioned adduces as an argument against the old ideas the fact that the surface more or less extended of foliage facilitates evaporation and scatters in the air a great quantity of rain, thus depriving the earth of the fecundating action which would benefit it but for the interposition of the leaves. The force of this objection is only apparent, seeing that from the calculations of Ebermayer it is found that the evaporation in the forests is two and a half times less than that of places outside of them and five times less according to Clavé, who adds that when we take into account that the ground is covered for whole months at a time by the leaves, which, having fallen from the trees, while they represent an excellent manure, form at the same time a kind of protecting covering, it is easily conceived that that circumstance diminishes the evaporation to the extent of even eighty per cent. It has been pointed out with much justice that it is not the quantity of rain received within a given time, but the even distribution of it, which constitutes an essential condition for the prosperity of the land, and Van Berber ("On the Influence of Forest Growth on Climate"), has shown that arboriculture, apart from increasing the rainfall, possesses a still more valuable climatic virtue in that it regulates the moisture and avoids excessive thermometeric variations.

What has been said so far will suffice to make the hygienist who has been called to study the degree of salubrity of any particular district view without indifference the proximity or absence of forests. The fact that they should have been held at all times as aids of the first order

towards the preservation of the life of man is well justified by the ancient theory of the respiration of plants, according to which the atmospheric air receives from them oxygen in greater quantities than those existing in ordinary atmosphere. It is true that there have not been wanting some who disbelieved the theory of the increase of oxygen as a direct result of vegetable respiration. When M. B. Corenwinder[1] gave an account of his researches on the chemical composition and the functions of the leaves of plants, proposing to definitely expound the question as to the breathing of plants, he set forth that up to that date it had been taught that they had two kinds of respiration, one by day and the other by night, and that the latter, termed the normal kind of respiration, is due to the absorption of oxygen and production of carbonic acid, the former, or daily respiration, being the effect of the action of the chlorophylla on the atmospheric air, the carbonic acid of which it decomposes —taking up the carbon and setting free the oxygen. Corenwinder ended by denying that that function of the chlorophylla is true respiration; he classifies it amongst the acts of assimilation, there being, according to his views, only one kind of respiration for all beings, and he added that, by means of minute analysis, he had established the existence of exhalation of carbonic acid in new leaves during the daytime, which phenomena is explained by the predominance in young tissues of compounds of azoe, these latter, organized in cells, being what exercises the respiratory function. At a later period, Ebermayer[2], in his excellent paper, "On the Hygienic Worth of Woods," refuses to accept as true the old assertion that in the air of the forests there is proportionately more oxygen and less carbon than in that of the plains devoid of trees. The Munich professor affirms that in his many experiments he has been unable to substantiate the exactness of such doctrine, seeing that in a space covered with trees he has not found a greater abundance of oxygen than in any other.

The group of dyscrasic complaints in which, owing to the want of hæmatosis, the introduction to the circulatory torrent of a stimulating air, laden with oxygen faithfully represents the *pabulum vitae,* is very numerous; and in any climate whatsoever there might be seen alterations, structural or functional, of the thoracic organs, in which even so precarious and insufficient a remedy as the inhalations of oxygen artificially obtained, affords relief to the patient. It will, consequently, not be difficult to make clear the great prophylactic and curative utility which in a vast number of cases an atmosphere laden with the products of vegetable respiration will possess, if, by chance, the ideas formerly

[1] Academie de Sciences de Paris, Marzo, 1878.

[2] International Congress at Vienna "On the Land and Forest in Their Economic Bearings."

generally accepted regarding this function and at present disputed, at length receive the approbation of science. But, even leaving out of the question the properties which I have touched upon, the most casual study of the matter reveals other great benefits derived from the cultivation of woods which fully justify the principle laid down in many legal codes in which the planting, preservation and care of woods are considered of public interest.

Amongst those benefits, some are obtained during the life or after the death of the trees, and are yielded by all plants susceptible of reaching a certain degree of development; whilst other hygienic and medicinal virtues are derivable only from a limited number of families and species.

The topographical configuration of some places dominated by considerable elevations or lying open to stretches of sandy and shifting soil, swept by more or less impetuous winds, exposes the dwellers therein to dangers and vicissitudes which, at times, imply the total and sudden destruction of life and property.

Thus, when from a chain of mountains a tremendous body of water is let down from the clouds upon a city, without the beneficent aid of forests intervening to withhold or check the force of its rush, the material damage caused by the torrential eruption may be frightful and wholly irreparable. Nor is it only the direct and immediate effect of the onslaught of the waters, which on such occasions, jeopardizes the public health. We have likewise to dread the vitiation of the air by the carcasses of animals which have perished by drowning, which float on the surface, dragged about in different directions by the rushes of water.

We find yet another consequence of the most serious effects and most difficult to combat, in the exposure to the open air of the substances which were formerly contained in the drains and which are now thrown out of them by the inundation which causes them to be scattered everywhere and to penetrate into the interior of the dwellings. The houses and the streets are damaged not only by the invasion of a huge mass of water, but also by the corrosive and injurious action of excrement, filth and refuse of all kinds which float on the top and poison the atmosphere, contaminate the wells, fountains and deposits of drinking water, impregnate the walls with an abominable stench, and, long after everything is dry, continue to cause illness and increase the death-rate by the effects of mephitism. Certain localities, such as upper Italy, Austria-Hungary, etc., are subject with a deplorable regularity to direful floods, the origin of which is chiefly to be traced to the destruc-

tion of the forests which has been ruthlessly carried on for a long time past.

If the snow which, year by year, covers the slopes of some mountains, did not find there forests which hasten the melting of the congealed masses, thereby preventing their conglomeration, as soon as the volume reached a certain magnitude, a sudden thaw would cast down into the plains below avalanches, the destructive rush of which would be irresistable. The suddenness and unexpectedness of the appearance of such phenomena, as well as the short space of time in which they attain formidable proportions, are highly suitable circumstances for the increase of the terrifying character with which they are invested. From this point of view trees, and especially those which grow on high places, play an important part in nature and confer incomparable benefits upon man. It is, in fact, a thoroughly well-proved fact that diseases of the kind referred to can only be avoided or remedied by the preservation and planting of woods to an amount proportioned to the defects of the local topography. However the rains may be, which fall on a valley and the adjacent mountains, if these be covered with vegetation of a certain degree of exuberance, the rain which falls on the plain will penetrate the ground at once, while that which falls on the mountains, its force being moderated by the foliage of the trees, when it reaches the ground will not be able to run with excessive rapidity over the slopes.

It will filter into them slowly and, if it arrive at all at the rivers which traverse the low-lying lands, it will never increase their volume to the extent of making them overflow their banks. "Wherever there are "torrents," says Surrel, "there are no woods; when woods have been "cut down, recent torrents have been formed. Woods are capable of "causing the disappearance of torrents already formed."[1] It is also by means of arboriculture that the consistent formation of those mounds or little hills of sand called "dunes," which are so prejudicial to the towns of the coast, have been prevented. At one time these mounds used to advance along the coast of Gascoigne at the rate of 25 metres yearly towards the interior, and to-day, thanks to the work of Bremontier, these "dunes" are covered with forests of pine, and that serious evil has ceased to exist. In the island of Bermudas mountains forty feet in height have been seen formed by the sand piled up by the winds. "These 'dunes,'" says Nynille Thomson, "end generally on the side fac- "ing the interior of the island by a more or less regular 'glacis' with an "inclination which never passes 30°. As new sheets come to be added "to the old ones, the result is that the *glacis* progresses gradually, in

[1] Etude sur les Torrents.

"vading and covering everything it finds in its way, to the great de-"spair of the inhabitants who see their lands invaded by the shifting "masses. Sometimes, however, the slightest obstacle that modifies the "course of the wind, changes also that of the 'dune.' But the best way "of checking it completely consists in planting on the crest laurel, rose "and juniper bushes which grow very well in the pure sand, or other "plants with very long roots, such as *ipomœa pes caprœ, conolaba uri-"fera and agrostis virginica.*"

The part played by trees in the meteorological phenomena due to electric currents deserves our closest attention. During storms they act as regular lightning conductors, staying the disasters of the sudden and explosive combinations which constitute the thunderbolt. They are the most efficacious protectors of the valleys against the hurtful effects of hail and moderate the course of the winds, thus causing regions known as "sanatoria," on account of varied climatic circumstances, to be habitable by invalids or valitudinarians who are always somewhat sensitive to the damages of inflammation caused by currents of either cold or excessively hot air. In general it may be said that the atmosphere of forests is fresher and its hygeometric conditions more elevated than that of open country. But what is of importance for the study of health is to know whether their temperature is usually even and not subject to sudden changes. I have already remarked that by the cultivation of woods we are able to maintain a certain degree of moisture in the ground. I will now add that by the same kind of work, places which are too moist, and, consequently, unhealthy, can be rid of such a serious defect until they be made fit for colonization. It is well known, in fact, that trees exhale through their leaves the excess of moisture which they have absorbed by the roots. In the high regions of the atmosphere that water is converted into clouds, which, borne along by the winds, is again converted into rain and goes to fertilize regions more or less remote.

In a much admired monograph, Professor Cantani (*"Pro Sylvis"*) has proclaimed the interesting fact that plants consume in large quantities the organic compounds from which sundry microbes and parasitic organisms derive their being. Other observers (Ebermayer) had already taught that the functions of vegetable life oppose the development of bacteria, and that it is rather on account of this property than on account of the purification of the air that the planting of trees in large thoroughfares and other public resorts is beneficial. Whether we consider trees as means of absorbtion and filtration or as disinfectants, the advantages of their preservation are palpable, and yet opposition has been made to it in certain parts of cities.

Jeannet[1] has said that they are the cause of darkness and that they keep the air damp, impeding the drying of the streets and increasing the cold of winter by intercepting the rays of the sun. To this argument Chevreul and Fonlagrines[2] have replied that, in climates which are blessed with sun there is no need to fear the interception of its rays in summer and that, as regards winter, the season in which light is desired, the leaves have already fallen from the branches, which, being bare, can no longer deprive us of solar illumination. It is in summer when the trees, being covered with leaves, can keep the streets damp, but, at this time of year, there is no objection to this dampness, as it is only superficial (the moisture of the subsoil being absorbed by the small roots), and helps to keep down the dust, acting as street waterer.

In fine, "alamedas," parks or gardens, whatever be the pecuniary sacrifice which they may entail, ought never to be omitted, seeing that they are not only the chief ornament of a city, a shade for the passer-by, a source of freshness for the soil and the best protection against these particles of dust which float about in the atmosphere and form so many more enemies to the sight and the lungs, but are agents, alike simple and constantly active, for the protection of our lives so frequently menaced by invisible hordes of pathogenic germs.

In the superficial layers of the soil of Göttingen, which were carefully studied by Nicolaier in 1855, a kind of earth was found which was neither more nor less than a very hive of bacilli, and endowed, most of them, with great virulence. Obliged, as I am, to refrain from giving a minute description of the experiments which were made with that infectious substance, I will merely say that where it was injected under the skin of rats, hedge-hogs and dogs it produced the whole train of symptoms characteristic of tetanus, and the death of the animal in a short space of time. Miguel has published numerous and comparative observations between the air collected in the most populous and central streets of Paris and that of the woods and gardens of the same metropolis. The results could not speak in higher terms to an intelligent mind for the purpose of showing how indispensable vegetation is to the public health. While, on an average, 3,910 bacteria were found to the cubic centimeter in the air of the streets, in that of the parks only 425 were found in an equal space. Pettenkofer, during the cholera epidemics in Bengal, has seen the troops encamped in the mango forests escape the disease, and Ebermayer points out that many people on this continent have been able to elude yellow fever by taking refuge in the woods.

1 Annales d' Hygiène Publique XLVII pag. 42.

2 Assani issement des villes: pag. 176.

In the curative treatment and even amongst the prophylactic measures for certain ailments, one of the principal elements is the inhaling of the effluvia with which certain classes of plants impregnate the surrounding atmosphere. In France, Austria, Hungary, etc., there exist forests of cone-bearing trees, the balsamic emanations from which possess such a marvelous regenerative virtue in diseases of the respiratory organs that from remote epochs they have been frequented as sanitary resorts.

In a learned article published in the "Lancet," mention is made of the services rendered by the groves of laurel to the south of Ostia, to the City of Rome, when she and her Campagna were scourged by the plague towards the close of the second century.

Many people escaped from death by emigration to the Rivière, to the shade of those laurels from the leaves of which they prepared an elixir which enjoyed a vast reputation as a specific against the plague.[1]

No one is ignorant of the difficulties presented by the restoration to healthiness of marshy lands and of the futility of the regulations respecting diet, dress, dwellings, etc., as a means of counteracting the action of the fever-bearing principle which is exhaled by the stagnant water. The train of dire symptoms which constitute paludic poisoning can only be avoided by costly and complicated works, either by distributing the water over the surface of the soil or turning aside its course by subterranean passages or, again, by carrying it off by means of elevating appliances.

It not infrequently happens that neither canalization by aqueducts, trenches, locks, dykes, etc., nor the hydraulic engines of great power which modern mechanical science affords to engineers are suited to some particular place or can be applied economically.

In such cases, we know from the time of de Bellegarde, by facts derived from tradition and from experience that, by stopping the currents of air by compact barriers of trees grown on marshy lands and situated in opposition to the prevailing winds, we can obtain most useful aids to dessecation and also manage to preserve the dwellings by means of a kind of curtain from the spread of the miasmas.

To this end use has been made of osiers, beeches, ash-trees, willows, etc., but no essence has been held in such esteem of late years as the eucalyptus. This is not the place to discuss the question as to whether that preference is justified on account of the eucalyptus really possessing the properties which have been attributed to it against the "microzoaire" of Laveran or on account of the facility of taking advantage of these trees of such rapid growth. In any case, and even limiting ourselves to the second supposition, it is beyond question that, by

[1] October 13, 1894.

means of their leafy extremities, they prevent the spread of unhealthy emanations and absorb, by the intricate expansion of their roots, water charged with organic matter, which they make use of for their nutrition and development to exhale afterwards to the clouds by evaporation purified of their harmful properties.

In cases of prolonged anemia and in marasm consequent on large losses of the nutritive fluids in difficult cases of convalescence, etc., the stimulating and vivifying air of wooded country regulates and refreshes the organic functions which are in a languishing condition, succeeding in very many instances which have proved intractable to the "materia medica" in restoring physiological equilibrium in all its force.

Many septic emanations markedly fatal to the human organism are neutralized in their effects by that oxygen modified by electricity, or condensed as to its molecules, known as *ozone*. This principle disappears or decreases, to a great extent, in large centers of population, in houses where there is a great agglomeration of human beings or animals, and even, it has been observed, in the atmosphere during great epidemics. As ozone is endowed with special curative properties in different kinds of morbid disarrangements, and as, furthermore, chemical analysis has shown that there is a larger amount of nasent oxygen where there is an abundance of plants than where they do not exist, it is clearly explained why removal to the neighborhood of forests and residence there of patients afflicted with the implacable proteus justly called *"suplricum neuricum"* should have met with such success and should figure amongst the most rational treatments known to modern therapeutics. To acclaim and spread the knowledge of the unquestionable value of a remedy which has no substitute amongst pharmacological agents is evidently necessary and befitting at the present time. Today, as a necessary consequence of increasing civilization, the influence of the pathology of the nervous system has gained ground, and especially the circle of certain neuropathic complaints.

Thousands of victims groan and struggle racked with unnamed sufferings, with unexplainable pains, which, not in a few instances, have been classified as imaginary and even attributed to pretense of many medical men unacquainted with certain kinds of studies and ignorant of the tortures of sensorial eccentricities. The calming and invigorating action afforded in cases of this kind by rest, solitude and the contemplation of the pleasing and inexhaustible fertility of nature, alike majestic in the forests as in the ocean, cannot be explained, as to its mechanism, by any dogma of common medical science. It constitutes one of the philosophical problems of the profession and will remain incomprehensible so long as we be without the clairvoyance nec-

essary to enable us to penetrate the most hidden phenomena of physical life. Let us then content ourselves with acknowledging the reality of that mysterious influence over the immaterial part of our being.

Thinkers, who are, from the very nature of their labors, subject to the hardest proofs and such vivid emotions that every instant of their lives is rendered bitter, and who consume their lives in so few years, are those who yield the largest contingent to the different forms of neurasthenia and other numberless manifestations of a disordered physiology. They also are those who, in favor of their exquisite sensibility, have found relief from their ills in the solitude of the woods on many occasions. "What person," says Balzac, "amongst those whose spirit "is cultivated, or whose spirit has received wounds, can walk in a wood "without the wood speaking to him?" Ebermayer recalls to us the ex- "ample of Lord Byron, who recovered his health in the "immemorial "forest of Ravenna."

Milton, blind, worn with age, grief and suffering, was unwilling to leave the gardens and parks of Richmond. Those enchanted gardens, says a historian, used to give him inexhaustible poetry in his wandering thoughts. In order to compose his sublime description of Eden, he had only to fall back upon the impressions he had received in the banks of Richmond, its meadows, its lakes, its oaks, all its wonderful vegetation.

When the apostle John Knox had to leave Edinburgh, fleeing from persecution, he found himself so ill and worn out by the mental excitement of his preaching that he could with difficulty reach the hut of a wood-cutter in midst of the forest. There he was seized with a prolonged fainting-fit, from which his disciples could not bring him out, and which, in those times, "Was reputed, in the Presbyterian Church, "as a divine dream."[1]

Sleeplessness and horrible hallucinations followed that lethargy for the space of several days. Only at the advanced hours of the night, and while in the open air of the mountain, could the reformer entice sleep, near a water-fall, the monotonous noise of which seemed to calm the excitement of his thoughts. At last he recovered in the healthy retreat of the Pentland Hills, and history teaches us how valuable for the reformation was the preservation of that life, animated by such a beautiful character.

It is of some interest to cite here the results obtained by Jeannet in his investigations relative to a demographic question intimately connected with the object of the present study.

[1] F. M. Sargant, "Life of Mary Stuart."

It is that which bears on the subject of the influence of forests on the average of births and deaths. In certain departments of France in which the cutting down of timber has been gradually carried on, serious difficulties have arisen from the point of view of health, as also difficulties geological and climatic. The birth-rate, according to the data obtained since 1871 by census, has gone on decreasing constantly in the thirty departments in which the cutting of timber has been practiced. And there, during the period of five years, from 1886 to 1891, there has taken place a marked depopulation, seeing that the deaths have exceeded the births to the number of 89,682.

Comparing the mortality of those departments with the average recorded in the rest of France, the former proved to be nine times greater. It seems useless to dwell upon the importance for the prosperity of a country of that cause of "oliganthropy" which is so powerful that it visibly weakens the race, depriving it even of the faculty of reproduction and life.

Long after trees have died, they still yield us important services such as that of supplying us with wood. Not only the heating medium imperiously demanded by health, but also every kind of furniture, instruments or utensils would be impossible to be obtained if that valuable substance were wanting. Though it may seem so, it is not an exaggeration to affirm that without wood no country could attain financial prosperity, nor political liberty, nor military power, seeing that it would be deprived of railways and the means of supplying artillery, naval works, mining works and the vast diversity of industries which work together for the creation and increase of the public wealth.

And let it not be said that we are speaking of things little connected with the public health, the *desideratum* which occupies the exclusive attention of this learned Association. The close connection which exists between one and the other is made clear by the following conditions.

The abundance of wood gives occupation to wood-cutters, carpenters, coach-makers, sculptors, charcoal-burners, etc., etc., all of them bodies of artisans who, while inactive, would not only fail to yield their useful contingent to the generality of the population, but would form a serious burden to it, as so many other weak and famished groups to whose wants the well-to-do classes would require to afford assistance within certain limits, for the preservation of social order. When the common people are convinced that they will not be in want of the means of livelihood afforded by work, they are not exposed to the anxiety, restlessness and fear for the future which depress alike moral

character and physical life. And the people who are not in the risk of falling into enforced idleness, do not contribute large numbers to swell the list of crimes, nor do they become corrupted by prostitution and vice, the baneful action of which on the most perfect constitutions and the most valuable lives is matter of universal knowledge.

To make a complete list of all the deadly infections, the organic sufferings or constitutional evils transmissible from parents to children, of all the death-bearing agents which are combated, weakened and overcome by the influence of the cleansing and vivifying energy which laborious activity prudently sustained exercise on the whole metabolic process would be to expose to public view so many more "loci comunis" of general pathology and prophylaxis.

I should never end were I to say everything relative to the beneficent influence of forests on the public health. The contents of this slight treatise will scarcely suffice to give an idea of the preponderating part which they are destined to play in the existence, welfare improvement of communities. "The preservation of forests," Martignac has said,[1] "is one of the foremost interests of societies, and, consequently, one of the foremost duties of governments. All the necessities of life are connected with this preservation. Necessary to individuals, not less so are forests to states. Their very existence is an incalculable benefit to the countries which possess them."

[1] Exposition des motifs du code forestier.

THE RELATION OF FORESTS TO PUBLIC HEALTH.

By JOHN C. SMOCK.

The influence of the forest is to reduce the range of temperature and to make a more equable climate; to check the air movement and lessen the force of the wind; to increase the relative humidity of the air slightly, and particularly in the warmer part of the year; to increase the rainfall; to promote a more uniform evaporation of moisture from the soil and earth surface; to reduce the percentage of the dust contents of the air; and to make the atmosphere more invigorating and tonic in its effect upon the human organism. The removal of the forest or the deforestation of a district tends to heighten the extremes of temperature daily and by seasons; to increase the force and destructiveness of the wind, adding to the dust contents of the air and intensifying its drying action; to favor the conditions both of drought, by insolation, and of flood by the more rapid discharge of the rain water on the parched and baked earth,—in a word to add to the intensive force of the climatic factors. The forests are the normal covering over a large part of the earth's surface; their removal is a great change in conditions and a derangement which gives opportunity for the clash of conflicting forces in the efforts at a restoration of nature's equilibrium. The reforestation of a part of the earth's surface is to restore the harmonious working to some extent and to make the earth more habitable for man. But man in the state of civilization needs land for the production of food. In this connection it should be said that the appropriation of the land to the needs of agriculture is not altogether so unlike the effect of forests upon the evaporation of moisture, the improvement of the drainage of soil and subsoil and upon the humidity of the atmosphere. The grasses of the pasture fields and the cereal crops are, as it were, miniature forests in some of their effects. A proper distribution of the forests, in relation to the cleared areas, appears to consist with the maintenance of the elements of climate which make the earth a more comfortable abode for man.

The influence of forest, which may be called chemical, is not as obvious in the effects as the physical, although in fact, these chemical reactions may be more potent. The production of ozone is perhaps the most important of them, although little is known of the conditions favorable to its production and retention in the various kinds of forest. Coniferous trees are said to favor its production through their resinous

constituents. The comparative examinations of the air of forest soils and that of fields in the open country show that there is much less of carbonic dioxide in the former. The more rapid decomposition of all material subject to decay, in the exposed surfaces of town and field than in the forest leads to the inference that the air above the surface in the forest also is less contaminated with noxious gases, and is therefore more health-giving. The comparatively insignificant volume of oxygen given off by trees, as compared with the wants of air-breathing animals, as man, makes this influence of little importance in relation to health. [Ebermayer and Puchner.]

What may be the exact extent of the intake of the more volatile matters of plants and trees and the volume given off by them are unknown, although they affect us so acutely by their strong odors, as for example—the terebinthine principles of the pine needles. The apparently antiseptic nature of the volatile matters of the eucalyptus is recognized, but not understood. The immunity through plantations of these trees against some miasmatic influences may be due to their great absorbing power of so rapid growth, and the shelter against the movement of air charged with noxious germs. The general immunity from malarial disorders in Australia where the trees are evergreen, even in marshy districts, indicates the possibility of some relation between this remarkable exemption from disease and the foliage of the trees. [Marsh.] Ozone, hydrogen dioxide and turpentine oil have antiseptic and germicidal properties and they are the products of foliage in the liberation of oxygen.

Observations in India by Dr. Pettenkoffer show that cholera and yellow fever are less prevalent in wooded districts than in the open country, and he cites cases where troops were withdrawn from the open country and the health was improved by the changes of camp. The healthfulness of the famous Dismal Swamp in Virginia and the prevalence of fevers in the adjacent cleared territory is suggestive of an intimate relation between the undisturbed, swampy conditions and the treeless areas. The observations upon the healthfulness of wet and swampy districts before clearing in part and drainage in an incomplete state are so common as not to need citation of examples.

These generalizations on the influence of forests are, however, subject to modification in different latitudes and in the different climatic provinces of the earth. The highest degree of health is to be found among the more intelligent peoples of the north temperate zone, although man alone of all the higher forms of animal life is able to live in the extreme conditions of all the climates of the globe and to thrive, from the tropics to the polar regions. He creates artificial climates, as

it were, in the face of opposing natural obstacles to life and survives through his mastery of these elements which war against his being. His environment is what he will have it. But the highest development appears in the temperate zones, where neither extreme heat nor extreme cold prevail, where the rainfall is not excessive, nor yet too scanty, and is well distributed through the year; where the winds do not parch the soil nor on the other hand drive the snow with a blizzard's force. The argument from geographical conditions shows that the high civilization of Western Europe is in equable climates, and in lands where forest protection is of so great importance as to be administered by governmental authority. The forest tends to produce equability, and equable climates favor healthful conditions. The general healthfulness of our Middle Atlantic States and of the Ohio Valley States, as compared with States to the north and to the south, is probably in part due to the more equable climate, and in that the element of forest covering plays a part. The British Isles, on the other hand, appear to show that deforestation is not unfavorable, but the relations of land and sea there make climates free from great extremes and the lesser influences of forest are safely neglected or regarded as unimportant.

If it can be maintained that the climates which conduce to the healthfulness of communities and countries are those which a proper distribution of forests tend to produce, it is logical to assert that they exercise a beneficial influence. On the other hand if the absence of all forest exposes a district to the extreme ranges of temperature, to violent winds, to sudden and torrential downpours of rain or blizzards of snow, to floods in its streams, to parched conditions of soils, baked by the fierce glare of unbroken sunshine or by hot blasts licking up all moisture and shrivelling plants and trees, the aggravating conditions are present to promote disturbances in the human organism also, and both his physical and mental well being are liable to suffer and to degenerate. If we had the records of disease by districts of characteristic topographic features, for long periods of time, to be correlated with meteorological statistics and with accurate data as to their forested conditions it might be possible to show the accurate relation of forests to the general health of the inhabitants of any given province or country. The statistics are not, however, all at hand, and it is impossible to express the value of our forests for our comfort and health, in any scientific form. The importance of forests as an element in the problem of public health is recognized, although its proper valuation is impossible.

Equable and warm temperature and humid air are recognized as favorable to some valetudinarians; others are antagonized by these

conditions and their susceptibility to predisposing disease is increased by them; therefore it is unsafe to characterize the influence of forests, tending to produce equable temperature, as beneficial in all cases. It may be true that moist air and equable temperature are agreeable conditions to the larger number of individuals and conducive to the general healthfulness of a district or country. The warm and more even climates of the Riviera and of Southern Italy are world-famous in making attractive health resorts, but a great part of the comfort realized in these places is due to their sheltered position. The Riviera is noted for its protection by the Maritime Alps against the cold north winds. Egypt, noted for its dry and warm climate, is exempt from the scourge of phthisis; the Isle of Teneriffe, warm and humid, also enjoys immunity from it. The argument from humidity, which forests tend to increase, is not apparent.

The rainfall has a close relation to healthfulness when in excessive amount or when it is distributed unequally through the seasons, producing wet and dry seasons, but the forest influence in the amount of precipitation is so slight as to be neglected in this discussion.

The shelter which trees afford and their resistance to the movement of the air, and timber zones as wind breaks, are evidence of the beneficial influence of forests. Indirectly helping by increasing the agricultural value of a district, and directly, by breaking the force of the wind and keeping down dust or stopping the progress of air laden with disease microbes, forests render valuable service to the comfort and healthfulness of a locality. Two of the famous health resorts of Europe are noted for the absence of winds,—Pau, in France, and Davos, in Switzerland, and this low air movement is a great factor in restoring health. Lakewood in New Jersey is a well known American locality which owes much of its healthful character to surrounding forest which arrest the winds. The health resorts of the South Atlantic States are all well sheltered from strong winds. The dust arresting influence of trees is remarkable. Tissandier found that the air of Paris contained six times as much dust as that of the country and twenty-four times as much as the latter, after a rain. A part of this great difference between city and country is due to the influence of trees, although not the larger part.

Another and indirect effect of the forest is the higher ground water and the smaller range in its position. In the open country the oscillation of level of the ground water is great and the low stages are coincident oftentimes with the prevalence of diarrheal disease. The evaporation in the forest is not so great and the drainage through the net of roots is better. The water of the woods has less saline and mineral con-

stituents and is more wholesome. On the other hand the stream water of swampy or flat districts of woodland may contain more vegetable matter than that of the open country. In general it can be said that the best gathering ground for public water-supply is one having a forest covering and not one wholly bare of timber. Probably here also, there is a happy medium, and the most desirable territory whence a public water-supply may be taken, is that where the slopes are forest covered and the hill tops and plains are in pasture or grass fields and cereal crops, with not too large a part in tillage. The question of water-supply is related closely to the extent of forested land, and its relation to the cleared areas.

To RECAPITULATE: The influence of forests in conserving the quality and quantity of the water-supply; in providing shelter against the violence of the winds; in favoring the more highly ozonized and dust-free air; and in lessening the range of temperature, and making the climate more equable, is evidence of a close relation to the healthfulness of a district or country and to the well-being of its inhabitants.

UNIVERSITY LABORATORIES IN RELATION TO THE INVESTIGATION OF PUBLIC HEALTH PROBLEMS AND TO COMMERCIAL WORK.

By ELLEN H. RICHARDS.

The problems of public health cover a wide range of subjects and demand on the part of those engaged in studying them a great diversity of knowledge. To restrict the present paper to such cases as require chemical training is not to claim more than is due to this branch of science, but only to use the examples more familiar to the author.

For instance, in deciding upon a municipal water supply not only is the character of the water itself (and the organisms which flourish in it) to be considered, but also the material for the lining of the reservoir which is to hold the reserve—asphalt, cement, etc.—and that of the pipes which convey the water, and in some cases even of the faucets which deliver it to the consumers.

Likewise in an examination of a sample of milk not only is an analytical knowledge a necessity, but an understanding of the changes liable to be brought about by organisms and of the habits of milk farmers and dealers.

The head of a sanitary laboratory should be a man of absolute probity. His opinions should not be purchasable at any price. He should have the somewhat rare quality of unbiased judgment and that still more rare of suspended judgment. He should be courageous; not easily browbeaten by any combination of capital. He should have skill in attacking a new problem—that is, be versed in methods of research—should be patient, yet quick in action, well balanced—not easily swayed by a new fad—and a good judge of men. For much of the detail work must always be left to assistants, however carefully the whole is supervised.

One who is color blind must not be given work which requires accurate matching of colors. (Many discrepancies in analytical work have occurred through this disability. Of the fifty or more students who pass through my laboratory annually, less than twenty per cent. of the men have a really good eye for color.)

The man who is slow in movement, if retained at all, should not be given weights to make, nor the one who is clumsy with his hands delicate appartus to manipulate. The efficiency of a laboratory depends

much on this careful selection of assistants. (In my experience, at least one woman to each two men makes the best working force.)

The work of a sanitary laboratory is really educational—that is, the results are for the information of the people or of those who are caring for the welfare of the people,—those who must protect them from their own ignorance and from exploitation by unscrupulous persons. Therefore not only knowledge but dissemination of knowledge must come from a laboratory dedicated to the service of public health. Experience tells in this quite as much as in the physician's case and even as the long training in the clinical wards of a hospital follows the medical school, so an experience in a well ordered laboratory would save many a chemist from giving a too hastily formed opinion. To such a laboratory there come instances of the greed of men which leads them to play upon the easily aroused fears of the public; of the skill of other chemists in making the worse appear the better food; of carelessness and stupidity beyond belief.

It is only after many mortifying failures to divine the real causes of observed facts that a chemist (or a bacteriologist) becomes wise enough to be a first-class detective, and this he can never be by staying in his laboratory and examining only that which comes to him. He must visit manufactories, must keep informed as to the patents issued, as to the new processes described and above all as to the work done in other laboratories not only in his own country but all over the world.

Work strictly bearing upon public health is done for (1) private individuals, (2) for corporations, (3) for cities, for States, for the Government. It may be done in (1) private laboratories, in (2) municipal laboratories, in State or Government laboratories, and (3) in laboratories connected with higher institutions of learning.

It is my purpose to discuss some of the advantages to be found in the use of the latter for such purposes.

The commercial chemist, if we may so designate the head of a private laboratory, is like a lawyer, open to engagement by any one. He must live by his profession. The temptation often comes to him to undertake a profitable investigation as to the best means of preparing an article of food which will sell for a high price, but which has no added value as a nutritive article if indeed it has not a distinct disadvantage. He may be asked to perfect a filter which will pass the credulous multitude but which adds a danger rather than lessens a risk. He has no legitimate reason to offer why he should not make an analysis of a spring water, which with his name attached will enable a shrewd promoter to create a demand for a water to take the place of

the town supply which has been diligently cried down because of a slight color or odor.

Again and most serious of all the disadvantages of the private chemist is that his range is apt to be narrowed by the demands of manufacturers and that therefore his opinion on many subjects cannot have full weight with the public.

In the second group are the laboratories supported by the city or the State. These may be of two classes, those in which no commercial or expert work is done and those in which it is more or less combined with research work In the latter class are most of the laboratories connected with the agricultural colleges in which by the very terms of their existence samples of water, fertilizer, etc., must be examined whenever presented.

It often happens that a chemist who has had no experience in a suitably equipped laboratory and who knows only what he finds in books is expected to report on the safety of a farmer's well, and he does it as cheerfully as the young medical student diagnoses his early cases before he has learned that life and death are in his hands.

For the municipal, State and Government research laboratories where sufficient funds are at hand to secure the very best men, and where the amount of work is sufficient to justify the employment of several specialists, there is only good to be said, provided the impossible can be made possible, namely, that political influence can be eliminated. There is the same danger here by the wholesale as in the individual laboratory, that pressure will be brought to bear in favor of one or another project as well as one or another appointee.

There remains the third class of laboratory in which sanitary problems affecting both individual and public health may be considered, and which is often called upon for commercial and expert work,—that in connection with a university or higher institution of learning.

In order to gain a patient hearing for what follows, I must beg a further consideration of the character of the work under discussion. It is undertaken for the purpose of adding life, health and happiness to thousands of citizens; *not* for money making; *not* for personal aggrandizement. Of what avail is it to cultivate men's minds and undermine men's health? What is to be said of the morality of educating physicians to make a living of men's ills and ignoring the fact that these ills need not exist if the knowledge in the possession of the university were disseminated among the people? Why should the public pay attention to the details urged upon them by sanitary cranks when they see the higher authorities in the country ignoring all matters relating to health as a normal condition of life? It is notorious that

the well in the college yard is one of the worst in the town, and the college halls are worst ventilated; the college table the most unhygienic.

Will not the fact that a university of established reputation in each State gives shelter and countenance to a laboratory of hygiene, and not in a medical school alone, do more to educate the people to an appreciation of their duties in the matter than anything else?

That State and municipal legislation alone without individual cooperation cannot keep pace even with the increase of disease due to increasing density of population and to foreign born parentage, and to luxury of living, is indicated in the registry reports of Massachusetts—a State supposed to lead in sanitary legislation.

In the period, 1851 to 1855, the death-rate of the State was 18.71 per thousand. In the period, 1891 to 1895, it was 19.83. In all foreign countries, except Ireland, it appears that the death-rate has decreased. Certain diseases like scarlet fever, which has fallen from 10 to 1 and less per ten thousand, have been controlled by the authorities, but this gain has been more than offset by the increase of equally preventable diseases due to individual carelessness and ignorance. For instance, heart disease increased from 2.12 per cent. of the total deaths in 1850 to 7.85 per cent.; Bright's disease and allied causes from 26.1 to 33.9 per cent. of the total, while there has been little change in the statistics of consumption. A legitimate inference to be drawn is that the public in general has not been sufficiently educated to avail itself of the means of more efficient sanitation.

When the university interprets "the highest study of man is man" to include a study of all that makes man a capable, efficient force in the world and his life a pleasure to himself and his friends, *then* we shall begin to see results more fundamental to society than any yet obtained by university training.

So far, as a rule, whenever any member of an educational faculty other than medical has undertaken the investigation of practical subjects, he has thought it necessary to apologize for it. Among the first to be so placed was Professor William Ripley Nichols of the Massachusetts Institute of Technology, who was employed in 1872 by the State Board of Health to conduct the examination of the rivers of the State, not that there was then any serious menace in them, but as a basis for future comparison. His work is too well known to be further detailed and is referred to because of the apology or defence he made for taking up the subject in one of the last papers he ever wrote, namely, his address (1885) as Vice-President of Section C., American Association for the Advancement of Science. As a professor in an institution

of higher education, one in which broad principles, not technical details, were taught; one which aimed at development of character by education, not at merely professional finish, and one standing for the then new idea of the educational value of laboratory training, he felt that he laid both himself and the Institute liable to misinterpretation. He says: "We are born men before we become scientists and although the attractions of pure science, studied for its own sake, may be very great, the application of the truths acquired to the good of our fellowmen ought not to be considered as in any sense belittling to our science." After citing many instances of investigation in the cause of health by the greatest chemists of past times, he continues: "It is highly desirable that even routine work, the ordinary investigations for sanitary purposes, of water, air and food should be in the hands of chemists well educated in their profession and imbued with the true spirit of science—the work of the sanitary chemist seldom ends with the results obtained; the interpretation and utilization of the results are often the most difficult part of the problem and one with which the chemist alone is competent to deal."

It is now recognized by students of educational tendencies that practical problems offer the greatest stimulus to research in pure science, that some of the most brilliant work of the past century has been done because of this stimulus. The person applying the result is usually a different individual from the one who makes the discovery, but if he benefits his race and advances civilization, is the former any the less deserving of a good name?

From the early years of their existence the chemical laboratories of the Massachusetts Institute of Technology have contributed to a fuller knowledge of the conditions of human existence.

In the spring of 1870, under the direction of Professor Frank H. Storer, a series of examinations of air for carbon dioxide were made for the then newly formed State Board of Health. The samples were taken from various "enclosed spaces," generally assembly rooms, schools, churches, theatres, as well as from the open air. In October of 1870, Professor Nichols submitted his report on the presence of lead in water after passing through lead pipes. In the autumn months of the same year Professor Nichols made a sanitary examination of Mystic Lake with comparative tests of other sources of supply. These three papers all appear in the second annual report of the Massachusetts Board of Health, and an examination of the reports from 1871 to 1897 will show the range and volume of work contributed toward the solution of public health problems from these pioneer laboratories.

During all that time what may be called commercial work, that is, work done for private information and paid for by individuals, has been constantly carried on. Several of the professors have had private assistants whose salaries were paid for by this means and whose spare time has been devoted to research which would otherwise be out of the power of the overworked professor to indulge in. As a rule such examinations as involve litigation are not made both because the time of the teacher is too valuable to be wasted in the court room and because to the scientific man truth is too precious a commodity to be smothered in its foul air. A large portion of this work has been done during the school vacations, or after hours, thus not interfering with the time and space given to the student.

In 1884, the laboratory of sanitary chemistry was fitted up apart from the others, in response to a demand from graduates settled in various positions for information as to methods of sanitary examinations which they had been called on to make. The course, of ninety hours, has been a flexible one, the notes having been rewritten eleven times in fifteen years, adapted to the needs of the times as far as possible, and the chief aim has been *education*, not information, in the hope that those who had taken it might become missionaries to the suffering public and might the better understand the limitations of their own laboratories and of their own knowledge.

The result has been most gratifying not only because of the few who have made public health work a profession, but in the fact that hundreds of young men have carried into hundreds of communities right ideas of what healthful life under modern conditions demands of the individual, the city, the corporation and the State.

Since there are no patents to be taken out on sanitary ideas it is of great importance for the educative effect that research work shall be going on at the same time in the same laboratory as is teaching and that the difficult problems which yet await solution shall be explained to the students; some among whom will be sure, in the course of their careers, to do much toward solving them, and who will at least go to make up that intelligent public which must be at hand before sweeping reforms can be carried out.

In such a laboratory the commercial or research work is only one of the many interests to the professor. The student must in no case be neglected, but the freshness of interest given by problems pressing for immediate solution, the wealth of material for illustration are stimulating to both and lead to better work on the part of both professor and student.

The most valuable possession of the university chemist or biologist is the knowledge that he is a *free agent*. He need not make any given

examination unless he chooses. There are the private laboratories to which he can refer all doubtful cases brought to him by private individuals. It is assumed that municipal and State work is arranged for between the authorities and the university with the concurrence of the individual, but also that the professor is at liberty to give a certain portion of his time to private work. He should not do this without pay, except rarely, as a physician may give his services, and he should not take advantage of the free use of the university laboratory to take a smaller fee than that charged by the private analyst, rather should it be larger, for not only should his results be more trustworthy, but his opinion should be worth more because if there is that fraternity which should prevail, his knowledge of the subject under consideration should be that of ten men,—for not only has he the resources of the university at his disposal, not only books and chemical apparatus, but also the brains and experience of his associates in other departments, a courtesy which he repays to them in turn.

For himself, the need of thinking quickly and planning systematically, is a stimulus not to be despised. Mental laziness is even more common than physical.

For all that the university does it should receive a consideration. It was a principle with Professor Nichols to devote one-third of all his receipts from outside work to the purchase of books for the chemical library, and thus was laid the foundation of that collection hardly rivaled in the country. This early tradition has been followed in many cases.

While the public analyst is as worthy of his hire as any other man the money lover has no place in the university. In most cases the assistants in the research and private work should be other than those devoted to the students, both because, as previously remarked, the student's interests must be carefully guarded and the class hour might coincide with a critical point in an investigation or with the appearance of a sample which must be examined immediately, and because it is rare that younger assistants possess the qualities of good research workers or of quick analysts and at the same time those of good teachers, careful in preparing material and patient in explanation.

The wise head of the laboratory will take care to supplement himself and make up his own deficiencies on either side by his choice of assistants.

A high standard must be maintained for the sake also of the students who are quick to detect a false note. Hence no commercial work is given to students. Their work is not for results but for their own development and it is never published except as explicitly stated

and vouched for by the professor in charge, with due credit to the student. The perfection of detail required would, in most cases, be too wasteful of time.

The university gains in public estimation for all the good work it does for the people who might never hear of it except for this advantage to themselves; it gains in students and in the appreciation of the best business men who are quick to value an honest opinion and an incorruptible servant. For these reasons it gives space and appliances and time of its employeés to a limited extent (this limit should be a reasonable measure under the control of the authorities). For its own reputation it should not permit any employeé not fully competent and not sufficiently loyal to guard against the subtle ways in which even the most watchful are beguiled, to undertake commercial work.

Therefore, for the investigation of questions of great import and wide bearing, the university laboratory is likely to be the best place just as soon as the university authorities realize its value as a factor in that higher civilization which must be the aim of all education. There is for the scientific man a great safeguard in that the name of the university must be protected at all hazards. Nothing must go out from its precincts less than the best. No taint of work done for advertising purposes, of help given to a process which is to defraud the public or endanger men's lives, no careless, inaccurate work must bear the stamp of the institution.

Consequently the position of the sanitary laboratory is becoming an important one in the community, since the wise householder is looking to it for assurance that the public authorities are doing their duty.

SOME PERSONAL EXPERIENCES IN DISINFECTION.

By WYATT JOHNSTON, M. D., Montreal, P. Q.

Bacteriologist to the Board of Health of the Province of Quebec.

My results cover the period of three years since formaldehyde has come into use as a disinfectant. The work involved a considerable outlay for apparatus, and although my board was liberal in granting allowances, they fell short by several hundred dollars of what was needed. I found, however, in private disinfection of houses after contagious diseases, the means of supplying what was needful, and in this way we obtained over $1500, considerably more than was necessary for the actual purpose of the experiments. I mention this detail to help others who are prevented from experimenting by want of funds.

Disinfection as carried on largely with various forms of formaldehyde, was incidental with that by steam, sulphur, and other methods. There seems to be no doubt that the best method for ordinary sanitary work is that by formaldehyde. There are relatively few conditions in which steam is necessary for disinfection, and formaldehyde, properly employed, fulfills all requirements for municipal and household disinfection, and does away with the necessity of transportation. I found, however, that under certain conditions the use of steam was indispensable, particularly where considerable penetration had to be obtained, and the process had to be completed in a short time. If the disinfector could be allowed one or two hours as a minimum, then formaldehyde was found sufficient. When it was necessary to make rapid disinfection, of clothing, bedding, etc., for instance, in a hospital, where the articles had to be used immediately afterwards, steam was found more convenient. Formaldehyde under these conditions emitted certain after-odors which rendered it unsuitable for rapid work.

We made some experiments with sulphur confirmatory of previous work. Sulphur gas was found to be very deficient in penetrating properties. We could not get the sulphur vapors to penetrate at all unless they were used in such a manner as to produce serious damage to fabrics. With the formaldehyde we did not have any trouble in the way of causing damage, and I have no doubt that has been the experience of others.

Steam, on the other hand, when only used as an occasional substitute for other methods, we found rather troublesome. If you disinfect clothing by steam, you may get a wrinkled appearance, which people do not like if unaccustomed to it.

With reference to the various apparatus employed, we tested the autoclave, worked under use of pressure, and it gave no better results than apparatus with no pressure. The Trillat apparatus and the use of the chloroformol did not seem to give materially better results than the other, although where the gas was dry the penetration seemed to be better. The use of a vacuum did not appear to influence the results in the manner which we expected, for it did not reduce the time limit to minutes, although it apparently made the penetration more effective. The use of heat (50° to 60° C.) in connection with formaldehyde made the disinfection act more prompt and complete. Of the lamps, that which gave the best results, was the one shown here by Professor Robinson, especially when it was used in a closed space. The penetrating effects obtained were considerably more than I anticipated; perhaps on account of the combustion causing an exchange of the particles of gas. It was not found practicable to use this method in ordinary work on account of the very high duty on methyl alcohol. I tried other lamps, but did not get good practical results.

The dry method by paraform tablets, was tried experimentally, and while in small closed spaces it acted well, the effect was unequal in ordinary rooms.

The various apparatus for boiling formaldehyde appeared to give on the whole the best results. After having used a number of different kinds of apparatus, I do not think so much depends upon the particular form of apparatus as upon the manner of its use. One can take almost any regenerator on the market and with care obtain good results. From the point of view of saving time, there is an advantage in using an apparatus that can be started and stopped instantly. The discharge of gas should be automatically controlled, which is best managed by ensuring that the pressure of the formalin is uniform and the flow constant.

I cannot say that I am fully decided as to the sprinkling method which has given such excellent results in Chicago, and which seems to commend itself on account of its simplicity and the absence of danger from fire, etc. I have tested it on a small scale, but not in routine household disinfection. The chief drawback is that in sprinkling formaldehyde on the sheet, the production of the gas became more and more intense, so that in five or six hours, when disinfection was complete and the room open, you have the maximum quantity of gas, and it is necessary to send someone to open the room; whereas with the ordinary forms of apparatus the gas would disappear by the time the room is ready to be opened, and there is little smell. I never find it necessary to go back and open rooms, and this saves half of the labor, as one visit suffices instead of two.

The pastilles have given me fairly good results for sterilizing small articles in small spaces. A suggestion made by Dr. Gehrmann has been found efficacious, that is, sprinkling layers of infected clothing with a little formaldehyde, and piling them together in a heap. This avoids the annoyance caused by drenching clothes or soaking them in disinfectant solutions, which is perfectly unnecessary. Such details may seem trifling, but anything which will lessen the annoyance to the public and tends to make disinfection more popular, will have a beneficial effect. The personal element enters largely into the matter of disinfection, and skill can only be attained by practice.

With reference to the amount of formaldehyde used and the degree of penetration obtained, I desire to state that penetration depends largely on the concentration of the formaldehyde gas. In a room where a person had been sick with scarlatina or diphtheria, we found we could easily get sufficient penetration to disinfect objects placed beneath the sheets or under the pillows, if we pasted up the orifices, and as a rule we used about one pound of formalin per thousand cubic feet. This took considerable time and was rather expensive. We found it was better to get what one might call local concentration, acting intensely with the vapors upon those articles which required most attention. If you thoroughly disinfect the sick-bed and its surroundings, you will have accomplished about ninety per cent. of all the disinfection needed in the room or probably in the house. By allowing the vapor to play beneath the bed, arranging the bedding so as to form the shape of a canopy or tarpaulin sheets, we get localized concentration of the vapor in this part of the room, and enough escapes to superficially disinfect the rest of the room. I found that we thus obtained as good results as when we simply introduced a larger quantity of the formaldehyde in the room. This plan of concentration reduced the cost, and four to eight ounces per 1,000 cubic feet sufficed. The number of dwellings disinfected was two hundred, nearly all the cases being scarlatina or diphtheria. There were two cases in which recurrence of the disease took place, one a case of diphtheria, and one of scarlatina, the recurrence following in each within a few days. The circumstances were rather peculiar in both. The scarlatina case was released from quarantine at the request of the physician less than four weeks after the onset of the disease. The patient was considered to have finished peeling, but there was a discharge from one ear. Another case appeared within six days in a child who was in contact with the patient.

The diphtheria case was interesting, as showing that the trouble was probably not due to faulty disinfection. Here we had two recur-

rences in the same family. I did not make the throat examinations in that case, as a professional friend of mine had made them, but he only examined those who were actually ill. After the first recurrence I made cultures of the throats of all members of the family, and found the servant in charge of the child had diphtheria bacilli in her throat; she was apparently the source of infection, though she had not been considered to be ill.

In one case I was asked to disinfect the premises after German measles, which is not regarded as a serious affection. I mention this because there were three recurrences in this family, first one child was attacked, then after an interval of some days another, and still a third child. Finally the cook was taken sick. In that case only part of the house was disinfected.

I may say, that the results I have given are such as one gets in private practice. They are not carefully compiled, and are not as applicable for general scientific purposes as in those cases where disinfection is carried on under rigorous conditions of examination. So probably my results will be of less value than those obtained by sanitary boards, though as far as possible I have tried to find out if recurrences took place. I think if some uniform system of tabulating results were adopted, we might get some valuable combination data.

REPORT OF THE COMMITTEE ON THE CAUSE AND PREVENTION OF CONTAGIOUS DISEASES.

By PETER H. BRYCE, M. A., M. D., Chairman,

Secretary Provincial Board of Health of Ontario, Toronto.

Mr. President and Gentlemen of the Association—Your committee begs leave to report that during the past year it has endeavored to keep in touch with the reports of the progress which has been made in the elucidation of the causes of the several communicable diseases, which are of practical interest and importance to those whose duties call upon them to take action with regard to such diseases.

The limits of this report make it imperative to confine our remarks to those points which, in the evolution of scientific medicine illustrate some new phase of disease or demonstrate some new fact, whether it be the causation (hitherto unknown) of some disease, or the prevention of some malady, which is now regarded as preventable.

Smallpox.—The past year has once more brought prominently to the attention of all officers of health, the fact that this disease, fortunately so long quiescent, only requires an opportunity in order to be disseminated with all its pristine readiness, if not with its old-time virulence. Certain areas of the continent have had the disease prevailing to a very serious degree, and health authorities have experienced in many instances great difficulties in preventing its spread. One very important reason for this has existed in the remarkable variation in virulence, which has marked the disease in many instances. Thousands of cases have occurred within the year in the United States, with a mortality not exceeding 5 per cent. The explanations of this from the biological standpoint would prove of extreme interest were we in possession of them; but owing to the great difficulties which have been experienced in cultivating the microbe of the disease, almost nothing has been established. We would seem to have to fall back on the old theory of acclimatization, or failing this, to the supposition that the habits of life of the people along with climate, have proved inimical to the development of virulence in the germ of smallpox. It has been a general observation that the virulence of the disease is notably less in sub-tropical than in temperate climates; but we have witnessed during the past year a winter of remarkable severity, yet incapable of developing the usual virulence of the disease, except in a few instances. That the disease may at any moment become malignant was, however, seen in the Province of Ontario, where out of

thirty-five cases, originating it is believed in a case from Cleveland, eleven deaths occurred.

That there are biological conditions in the individual, influencing the development of virulence in the microbe, may legitimately be concluded from the extremely valuable experimental observations made by Béclère and Chambon, of the Institute of Animal Vaccine, Paris.

The experiments were made with the object of determining the effect upon vaccine lymph produced from vesicles in vaccinated animals previously treated by means of hypodermic injections of the virus. A very notable reduction in virulence was the result; while similar results were obtained in animals inoculated subsequent to an injection with blood serum from vaccinated animals, as horses and cattle, and from men and monkeys suffering from smallpox.

The conclusions briefly summed up, were:

First. The serum of a heifer taken fourteen days after inoculation, is endued not only with immunizing properties, preventive and curative, but it also produces when mixed with vaccine, an anti-virulent effect.

Second. It produces in horses and probably similar animals, the same anti-virulent properties as in cows and men.

Third. Vaccination produces the anti-virulent property on the serum, however the inoculation be made, whether by the skin, the blood, or the deeper tissues.

Fourth. The serum from convalescents from smallpox exerts the same anti-virulent action on vaccine as does that from variolized animals, as monkeys.

Fifth. The anti-virulent substance of the serum of man and animals immunized against vaccine and variola has a stable composition, offers great resistance to heat, light, time—persists when dried and does not readily putrefy.

Sixth. The blood takes several days after inoculation to acquire anti-virulent properties fully; in the heifer after from nine to thirteen days, and is at the very moment that the vaccine or variolous virus loses all activity.

Seventh. The period of vaccinal immunity varies much with different species, but the anti-virulent property of the blood goes on decreasing, and may disappear completely, although the skin in the same person may still resist re-inoculation with vaccine.

Eighth. The anti-virulent property varies with different persons, but persists for twenty-five years and even fifty or over, with persons against variolous and vaccinal infection.

Ninth. The production of the anti-virulent substance in the course of vaccinal or variolous infection and its appearance in the blood

plasma, constitute a reaction of defence of the organism intimately allied to the arrest of the morbid process, and to the development of immunity. We do not yet know whether this substance acts directly on the infective agents as a virulicide or whether it acts as a stimulant on the tissue cells of the organism.

The practical diagnostic difficulties, owing to very notable variations in the normal signs of the benignant disease, have doubtless been experienced by many of us; but practical experience must have similarly led to the conclusion that nothing less than the application of the time-honored measures of complete isolation of patients, and the vaccination of all exposed persons, has proved efficacious in stamping out an outbreak.

Some of the more specific differences connected with these outbreaks of modified virulence, have been discussed in that portion of the committee's report by Dr. Suiter, dealing specially with the matter.

As regards, however, the biological meaning and interpretation of this remarkable modification of the type of smallpox, I take pleasure in referring to the very admirable references to the general principles underlying the difficult question of immunity and modification of virulence in disease, contained in that portion of this report prepared by our confrère Dr. J. E. Monjarás, of San Luis Potosi, based on his own experiments.

Thus, after referring to the continued presence in the alimentary and respiratory areas of morbific germs, indefinitely, until the opportunity for their invasion arises from within the system. He says:

"We must therefore give less credit to the influence of contagion in "the development of transmissible diseases and modify our present "explanation thereof, which gives such a great importance to the con-"tact of pathogenic microbes in the system, as we have seen that in "some cases this contact is entirely innocuous.

"For us the contagion arises not when the microbe comes into con-"tact with the surface of our tissues, but when it commences to flour-"ish inside of them, giving rise to the development of a culture, that at "first is strictly local."

Again after referring to the influence of cosmic influences, as temperature, humidity, electrical influences, etc., the report states:

"In fact, we cannot entirely separate a body in a state of activity such "as the cell, from its environment without endangering the phenomena "of its life, or vitiate these conditions without injuring the system of "which it forms a part; its activity producing certain products, as has "been demonstrated by Hallopeau and Gautier in Moscow.

"The causes that may influence the cellular activity and determine "the appearance of toxic substances in the system, can evidently, as

"well proved by H. Boucher, only proceed from two sources; either "from the system itself, which alters nutrition, according to the con- "ditions of strength or weakness in which it finds itself, or from the out- "side matter in which it moves, and by which it is surrounded on every "side and whose qualities produce an incessant variation.

"It is therefore in these media so variable in their composition, where "the specific determining causes find that principal co-operation with- "out which the other causes generally are left impotent for the develop- "ment and spread of transmissible diseases. It is in the extensive "variations of the environment, that we must look for the mechanism "that presides over the appearance of the infectious principle."

Nothing can be of greater importance than the thorough investigation of such problems of environment as are thus referred to by Dr. Monjarás, and in our northern climates where for months the whole population are domiciled in what I have called, in a previous publication, *artificial clemale's*, the direct influences not alone of microbic air impurities, but also of the increase of carbonic acid and organic animal products and of the decreased amounts of oxygen and its nascent forms due to electrical action, attention may again be drawn to their importance. Further than this, we might determine with accuracy the influence of decreased atmospheric humidity, and the effects of the unequal distribution of temperatures on the body by cold wall currents, cold floors and draughts upon the thermic centres of the body, which govern the cellular functioning organs.

The work in this field hitherto done, is but preliminary to what is necessary to be done before the relative importance of the immediate cause and the exciting cause of each contagious disease will be determined.

Insects as Disseminators of Disease.—The year has been fruitful in experimental work and discoveries in a field, which if not new, is one which has hitherto received but little attention.

Diptera.—So early as 1870, Davaine attributed to flies an important part in the spread of anthrax, from dead infected materials to living animals; and in the past five years, positive experiments have added much to the knowledge of the subject. This subject was briefly but very admirably set forth in a paper which appeared in our last Transactions, by Dr. Roman Ramirez, Lacubaya, Mexico. He pointed out that the internal formation of many *diptera* is admirably adapted for the collection of all sorts of small objects on account of the microscopic hairs that cover their bodies and legs. He further points out that several species of flies, by sucking the blood of diseased persons, can transmit disease.

Dr. Veeder, in the same Transactions, points to certain localized epidemics of dysentery investigated by him, as caused by flies through their carrying infection from fecal matter.

In a paper read before the section on "Tropical Diseases" of the British Medical Association meeting, held in August last, Dr. George H. F. Nuthall, Demonstrator of Bacteriology at Cambridge, England, whom this Association is proud to call a member, and a native of America, has given this whole subject in review in a most interesting manner. He says, insects play both a passive part as carriers of disease, and a more active part in some species as becoming hosts of the several germs, and thus through bites, inoculating the wound with the virus.

Dr. Manson in Hong Kong, in 1894, noticed many dead flies in his laboratory, and caused the death of an animal by inoculating it with the contents of a fly. The fly was seen to contain bacilli of the plague. Hankin in India, in 1897, found that the excreta of certain ants contained virulent bacilli after being fed on rats dead of plague. He thought such ants might be carriers of the disease to living rooms, through their excreta being deposited as dust.

Similarly Manson, Haffkine and others, have found the cholera spirillum in the intestines of flies, and sterilized milk has been found to have been inoculated with flies taken in a prison where cholera prevailed.

In the last annual report of Surgeon-General Sternberg, the part played by flies in the dissemination of typhoid fever in the permanent military camps of the United States Army during the Spanish-American war in 1898, is referred to. The report states: "At the time of "the outbreak and rapid spread of the disease, all the camps were suf- "fering from what many reports characterized as the 'plague of flies.' "Clouds of these insects swarmed about fecal matter and filth of all "kinds deposited on the ground or in cesspools or sinks, and conveyed "foul and infectious matter thence to the food exposed while in prepa- "ration in the camp kitchens, or while being served to the men." Inasmuch as some diptera are blood-sucking flies, and as Celli and Alessi are reported having isolated virulent typhoid bacilli from the excreta of flies, it is in keeping with what is known now regarding the mosquito, that such may actually inoculate the blood with the virulent bacilli of the disease.

Equal or even greater interest attaches to the work first systematically begun by Dr. Patrick Manson, LL.D., when, in China, he first made the observation that the filaria Bancrofti is communicated from one individual to another through the agency of the mosquito; interest in which was still further notably aroused when Dr. Major Ross, in Calcutta, described the life-cycle of the hæmatozoon malariàe as taking

place through the agency of a particular species of mosquito, the anopheles claviger. The recent report of the German Commission to Italy on "Malaria," includes, however, the culex pipiens, or grey mosquito of Ross (carrier of proteosoma or parasite of birds), as being in Tuscany equally with anopheles, the host of the germ.

In a very recent paper by Prof. Koch, on "Malarial Parasites," the life history of the two species is set forth, and, as being largely confirmatory of previous work by Dr. Macallum, of Toronto, and Dr. Major Ross, is of special interest.

Summarized, it is as follows as regards both Halteridium and Proteosoma, the parasites of birds:

1. Young parasite—composed of chromatin neucleus, very scanty plasma and no pigment, lives in or on red-blood corpuscles.
2. Adult parasite—chromatin, pigment and relatively, considerable increase in plasma.

From this point development may proceed in two ways:

3. (*a*) Endogenous (that is, in the body of principal host, as birds, etc), simple division into numerous small particles which commence these cycles afresh, abandoning the pigment of the mother cell.
4. (*b*) Exogenous—that is, in the body of its intermediate host.
    1. The mosquito parasite leaves the blood corpuscle and can be differentiated into male and female.
    2. Formation of spermatozoa and impregnation of female spore.
    3. Conversion into vermiform bodies which,
    4. Pass through the stomach walls and form coccidia-like spheres in which
    5. Sickle-like bodies develop.
    6. Passage of these into the poison glands and possibly other organs.
    7. Infection of principal host.

The experimental work necessary to lead up to the beautiful results of Dr. Major Ross were obtained by him by means of the grey mosquito, infecting sparrows with the proteosoma. After proving the fact of the transmission to sparrows of the disease, he endeavored to work out the life history of the pigment bodies found by him in the walls of the intestine of mosquitos. He found these *somata* or black bodies occupying spaces in the muscular walls of the stomach; there growing for seven days to such an extent as to seem like a wart on the outer walls of the stomach, and likewise into the body cavity of the insect. There were groups of these full-grown pigment bodies called coccidia, which could be made under pressure to burst their body-walls, or will do so in evolution, by the growth of the contents. These consist in

certain peculiar bodies called germinal rods, which are very minute, somewhat flattened bodies, and are present in enormous numbers.

They have not very definite locomotive powers, and evidently are by direct passage and osmosis diffused into the blood current. He found that in this way they are carried to the veneno-salivary glands, which consist of a number of plump cells along a branching duct. There is one gland on either side of head or neck; innumerable germinal rods or sickle-shaped bodies were found by him in the cells of these glands, like groups of bacilli.

The long ducts of these glands, on being dissected, were found to end in a common trunk in the proboscis of the mosquito. The proboscis runs under the head in the middle line, enters the base of one of the stylets or lancets of the proboscis, the central impaired one, called the tongue or epipharynx, traverses its whole length and opens at its extremity in such a manner that the secretion of the gland must be poured into the very bottom of the wound made by the piercing proboscis.

The secretions of the glands are, it is assumed, poured into the wound for the purpose of checking the spasmodic contraction of the torn capillaries of the skin, which would otherwise quickly stay the flow of blood from the wound.

So much then for the immediate cause of malaria.

The reports of the malaria expedition conducted by Major Ross to the west coast of Africa, repeat the statement from different stations, that the anopheles, the mosquito of pools, wherein vegetable matter is present in abundance, and not the domestic mosquito of the water barrels, is the carrier of the malaria germ. It has a long proboscis, has a different habit or attitude when at rest, and is marked by its dark spots on the edge of fawn-colored or dark greenish black wings. It bites at night and is often found asleep during the day. In forty-eight hours after feeding, the stomach becomes empty, and the eggs are laid. The insect is then ready to feed again, which if the mosquito has been put into a bottle, can be effected by placing the mouth of the bottle on the hand of a man, when the anopheles gorges itself. It voids blood likewise in sucking.

The larvæ further are different from those of the common *culex*.

The eggs, too, are different, and when laid attach themselves to objects floating on the water pools, and hatch in twenty-four hours.

Propagation of the Plague by Fleas.—During the past year there has appeared in "Annales de L'Institut Pasteur" a series of remarkable chapters on the propagation of the plague, by D. P. L. Simond, which, from their comprehensive character, illustrates the best traditions of the school of that Master of Science, Pasteur. Simond's paper reviews

the origin of the epidemics of plague observed since 1893 in China and India, based on his own personal investigations in Tonkin and later in Bombay. In tracing its spread he brings abundant evidence to show that while man may be the occasional agent of the transmission of plague, he is only indirectly so, and then points out the rôle played by rats as the principal source of its propagation. In general he states that the epidemic of plague is preceded by an epidemic swarming of rats, and points out from many illustrations that the first persons attacked with plague are in those quarters where grain is stored up and who are actually the men employed in granaries and store-houses, as along the quays; and further illustrates how, through rats in the holds of ships, the disease is carried from port to port. It is pointed out further that the contagion from person to person in hospitals is wholly exceptional, and that many physicians in plague hospitals refuse to admit the contagiousness of plague.

It is further true that in a centre of plague, observers soon cease to find the dead bodies of rats, while the plague is strictly confined to the population. Captured rats in such cases, however, show in many instances an immunity to the disease by inoculation.

By experimental observation Dr. Simond has shown that inoculation through infected food given to rats takes place but seldom, and gives the details of a series of experiments with the flesh of animals dead of plague, guinea pigs were inoculated with the disease, when practically all failed to produce the disease. The same result occurred when infected meat was fed to a young monkey.

Simond thereafter discusses these facts, favoring the dissemination of the disease through the medium of parasites. He was especially directed to this possibility through the ease with which the disease was determined by sub-cutaneous inoculation of the smallest doses, and the extreme difficulty experienced by feeding experiments. Observation soon determined the fact that in certain plague stricken persons there was present a phlyctenule or pimple, varying from the size of a pin-head to that of a nut. It appeared at the beginning of the malady, in general before any other symptoms, and contained a fluid at first clear but later sanguino-purulent. At first a papule, then a bulla or lenticular vesicle, and then it may recede, or break down into a pustule, leaving an inflamed base, extending into a gangrenous or necrotic ulcer,—thus the name, "Black Death." These initial papules are always on those parts of the skin where the skin is most delicate. In all, the fluids prove the presence of the bacilli of plague. Simond illustrates the occurrence of these by cases of accidental inoculations of themselves by physicians by means of needles, knives, etc. Such do not occur when the cultivated microbe, nor the blood of an infected

animal or its excretions come in contact with healthy skin. After such a series of observations Simond remarks, "It appears to us that only a parasitic intervention could be responsible for the penetration of the plague bacillus into the healthy skin."

To the flea and the louse he then naturally turned his suspicions. The flea found by Simond on rats in India was of medium size, and gray in color, with a dark red line along the sides of the abdomen,—being shown to be simply the stomach filled with blood; and he found that transported from rats to a dog or a man it bites them at once. When a rat is sick these fleas invade his fur by hundreds and gorge themselves with his blood. The contents of the intestines of such fleas were found by Simond to have bacilli of plague present, and that inoculations of rats with these intestinal contents have resulted in a speedy death.

Further, an infected rat with fleas on him was placed in a cage adjacent to a healthy rat, but quite separated by a wire screen. The healthy rat became infected and was dead within five days. Not always, however, did the experiment succeed, because the healthy animal, like dogs, defends itself against fleas. No infection from rat to rat ever took place in Simond's experiments where they were placed side by side in cages but when fleas were absent from the sick rat. The assumption by observation of Dr. Simond is that during suction the flea deposits at the point of attack a liquid drop of digested blood, the latter being a culture of the bacillus of plague. By experiment Simond has shown that in cases where the culture of the plague is virulent the bulla is often absent at the point of inoculation, but the papule or phlyctenule occurs if the virus is benign.

Such are the principal experimental facts on which Simond bases his conclusions as to the agency of fleas on the spread of the plague; and he further points out that it is just in those habitations, badly constructed, crowded and insanitary, where the population are uncleanly and become the victims of body parasites, that the disease prevails. He further points out the ineffectual results of disinfection as being due to the fact that these body pests would escape destruction in most cases; as well as to the fact that in the clean, well-conducted wards of hospitals the disease is practically not disseminated.

In this resumé of the part played by insects in the dissemination of communicable diseases, whether by carriage by the insects, as on the wings and feet of flies, by the injecting through the saliva or fluids of the glands of mosquitos of the hæmatozoon malariæ and of the filariæ, or by the depositing of the infected dejecta on points of inoculation, we have an ample opportunity for the exercise of the scientific imagination regarding the ever new phases of the biological problem of the

intimate relation man has with his environment. We see from such illustrations how accurate were the generalizations of the old Aristotleans, who believed plants might be engendered from the tissues of animals and that certain lower animals take their origin from within the substance of plants:

> "Nonne vides quaecunque more fluidove calore
> Corpora tabuerint, in parva animalia verti?
> ——— de putri viscere passim
> Florilegae nascuntur apes."—OVID.

But our time will not permit further detailed examination of the varied life processes of that insect life, which has proved of so much interest and of which so little is known.

As regards, however, the prevention of diseases of this class, the history of the several experiments as to the part played by insects, whether flies, mosquitos, or fleas, in the dissemination of disease brings prominently into view the old first principles which have again and again proved themselves to be the basis of all sanitary progress. We turn back to that marvellous series of reports by Dr. John Simon, the greatest of all sanitarians, and read his report of 1874 on "Filth Diseases and Their Prevention," as an inspired scripture, and find there the very details of work necessary to prevent disease. Applying them to the prevention of the several diseases we have been referring to we find all summed up in his first paragraph, viz:—"Remove the causes of uncleanliness; that is, remove filth." He then illustrates the varieties and degrees of filth as (*a*) putrescent refuse-matter, solid and fluid, causing effluvia and pollution by soil soakage; (*b*) overcrowding, thus polluting the two sources of health, air and water.

Applying this, we would say:

1. We may, as regards typhoid, arrange the garbage and sewage disposal works of houses, towns, camps, so as to make impossible local accumulations of organic vegetable and animal pollution, wherein the typhoid germs may grow and from which they may be carried to food and drink, as urged by Sternberg.

2. By drainage prevent soil pollution by either vegetable or organic matters so that mosquitos may breed in the vicinity of habitations, and so be in a position to become disseminators of the malarial parasite, as urged by Ross. Further, if they are present, protect houses against them, especially at night.

3. By so constructing houses as to render them difficultly accessible to rats, and to maintain in these such a condition of cleanliness of rooms, clothing and persons that infected matter will not be present, or if introduced will not have fleas to carry it.

4. As regards ships, the very means which are now in practical operation at all well-equipped quarantine stations will amply serve to destroy rats, e. g., sulphur fumes and formol.

5. By maintaining passengers no longer than is necessary for the disinfection of the ship and the elapse of the period of incubation for the plague of five days, to which, in the presence of actual infection, may be added a protective inoculation.

PREVENTION OF CONTAGIOUS DISEASES.

By FRANK W. WRIGHT, M. D.,

Health Officer, New Haven, Conn.

It seems to be the custom for sanitarians to discuss fanciful theories rather than the practical questions that are daily met by those actively engaged in municipal sanitation.

Contagious diseases we always have with us, and their suppression or at least, minimumization, is of vital importance to any community.

It is expected that he whose duty it is to assist in preserving the health of a community, will be progressive and attempt, by all means that are practicable, to so educate the people as to the necessary measures to accomplish this, that they will co-operate; but when his views are so far advanced both in theory and practice, that they cannot be understood, or he attempts to enforce the law so rigorously that the people consider their rights to be encroached upon, he is going beyond his duty, and doing irreparable injury to the cause.

That there is a gradual advance in public sentiment is certain, and it is just as certain to those whose duties bring them almost constantly in contact with contagious diseases that measures cannot be successfully enforced, that do not have the support of public opinion and that this opinion will sustain more and more rigid measures as fast as it is demonstrated that good comes from them.

From a very early period in the world's history, it has been recognized that certain diseases are in some way conveyed from place to place and from one person to another, and there has been some attempt to limit these diseases when they become epidemic. That these diseases were rendered more communicable by certain acts of mankind, was also recognized.

As early as 1500 B. C., the Egyptians formulated certain hygienic rules. The ancient Jews also enforced many sanitary regulations, but to give them the strength and support of public sentiment, they were made religious rites. As the world became more enlightened and as these diseases have become better understood, more effective regulations have been adopted. It is to be presumed that in all these years there have been many persons, as there are at the present time, who could not see the wisdom of these regulations, and consequently put many hindrances in the way of those who were to enforce them.

At certain periods the cause of contagious and infectious diseases was attributed to conditions of the earth and atmosphere, and it is not im-

probable that, to a certain extent, such is the case, but these conditions must be regarded as secondary to the now generally accepted causes. It is only within very recent years that anything definite has been known as to the real cause of a contagion being conveyed from one person to another. Bacteriologists have shown us that the causes are micro-organisms that are capable of being conveyed from place to place and from person to person, and that contagious and infectious diseases only invade new localities as communication by persons and commerce acts as their means of locomotion. Bacteriologists, in studying the life of these germs, have also studied how they may be destroyed. They have gone still farther and in a few instances, have produced an antitoxine, and as time goes on, will produce more, so that it is very probable that many living to-day will see antitoxines for both the curative and preventive treatment of nearly all of the diseases caused by micro-organisms.

To cause a contagious disease there must be at least two conditions: First, there must be the poison or germ of a particular disease, and next there must be a peculiar susceptibility, whatever that may be, to this disease. Neither one of these conditions in themselves can do harm, but by bringing them together the disease is produced, which in turn produces more micro-organisms, and these being disseminated, may meet other susceptible persons.

To prevent the spread of these diseases, two objects must be accomplished: First, the destruction of the poison given off from the sick one, which is called disinfection, and second, the prevention of any poison that has escaped disinfection, from coming in contact with susceptible persons. Therefore isolation. There is one other way in which certain diseases may be limited; that is, by rendering persons immune by inoculation, as in small-pox and diphtheria. It being now practically impossible for the former of these diseases to obtain a firm foot-hold in any well vaccinated community.

If therefore isolation and disinfection, which are so easy, will prevent these diseases, why are not these complaints entirely done away with, or at least reduced to a minimum and kept there? The answer to this is the practical side of the question. Theoretically isolation and disinfection are possible, practically they are not, and why? Because of the lack of co-operation by all, and the indifference of many.

The persons who can and do do the most to assist in this labor, are those of the medical profession. These, by the nature of their close relation with the family, are in a position to advise as to the measures to be pursued in a home attacked by a contagious disease; they can report their cases promptly to the authorities, that others may be warned and official action taken to confine the disease; they may also render

substantial aid by expressing confidence in the authorities and in the regulations. This, by far the larger part of the profession do. But there are enough in every community, who, inspired either by petty jealousies, or pure perverseness, conceal their cases, or report them too late for the public to be warned; who neglect to instruct the family as to precautionary measures; who cast insinuations upon the competency of the officials of the health department, and evade, as far as possible, all regulations. Some even going so far as to advise those who place implicit confidence in them, that the whole business amounts to nothing. Half a dozen physicians of this kind interferes with any system, and renders ineffective the services of a hundred who lend their support.

The people, themselves, are gradually becoming aware of the fact that contagious diseases can be controlled by attention to disinfection, and that the sick should be separated from the rest of the family. It is truly surprising to see the zeal certain persons exhibit when their neighbors are afflicted, but they themselves, illustrate that "familiarity breeds contempt" when their own families are attacked, and disregard all sanitary precautions. This feature is not confined to the ignorant, but rather is to be seen among those who are regarded ordinarily as intelligent people.

One may pertinently ask, why not enforce the laws? My experience is similar to that of others, namely, that the courts do not sympathize with the health departments, and will not prosecute those who flagrantly violate the health ordinances, or if they do, either require impossible evidence, or push the matter with so little energy, that the effort reacts to the injury of the department.

The effectiveness of the sanitary work of a city, is in direct proportion to the amount of money allowed for it by the city councils. The suppression and care of contagious diseases are necessarily expensive, and as politics, to a considerable degree, control appropriations, it cannot be expected that non-partisan health boards will be generously dealt with.

As it now is, an injustice is done to the poor man, whose family is attacked, if the case is reported. His boss, who, when he has the same trouble in his own family, insists there is no danger, immediately lays him off from work. He thus loses his source of income and is obliged to run in debt or become a public charge. Consequently he conceals, if possible, any sickness of a contagious nature in his household.

There are certain persons that argue that our most common contagious diseases are maladies that can best be borne during childhood, and that by preventing them during that period or in early youth, we are rearing a population of adults, who are liable to contract these com-

plaints with more fatal and disastrous results, both to the afflicted, and to the community in which they reside. These people by their actions and influence, greatly obstruct the work of health boards.

Epidemics do not often begin as such, but have their origin usually from a small beginning, gradually spreading from person to person, costing valuable lives and much money, which might at first have been easily avoided by a little care, and a few well spent dollars.

The first requisite is uniformity in health laws and usages, thoroughness in any locality being to an extent useless, if an adjoining town is negligent in adopting and enforcing proper precautions.

A medical man should inspect the schools daily, and examine each child that seems to be ailing; he should also inquire into the cause of illness of those who are reported sick, and in case of doubt, personally examine them.

If a disease at all suspicious should be found, all children of the family should be excluded from school, until an accurate diagnosis can be made. The writer is convinced that children with mild cases of diphtheria and scarlet fever occasionally attend school throughout the whole course of the disease.

A good hospital for the accommodation of contagious diseases should be maintained in every city. The writer found a short time ago, by inquiry, that of the sixty-two principal cities in the United States and Canada, less than one quarter were provided with decent contagious disease hospitals. Some not even having a place for the care of small-pox. All cities should be compelled by law to provide a hospital for the care of these diseases. Smaller places could easily and cheaply provide sectional hospitals, that could be taken down and transported from place to place, as required for the use of those who could not receive proper domicillary care. Such would possess the advantage of being easily disinfected. A hospital to be complete would necessarily require modern disinfecting apparatus, an ambulance, trained service, and a detention building for the accommodation of those suspected of having a contagious disease.

In addition, boards of health must have liberal appropriations of money for the care of the sick, and the full and free support of the medical profession and the public at large. The dread of small-pox at this time, and public sentiment will sustain any measures for its suppression, no matter how radical. This same feeling is gradually being developed in regard to scarlet fever and diphtheria, but it has not reached the point where it demands the prompt and decisive action which it should. It does not always sustain such action, which is just as essential as the work itself.

The expense of limiting these diseases would at first be great, but if we could with accuracy determine the aggregate expense to both in-

dividuals and municipalities, I am convinced it would be found that it is costing more now than would be necessary to carry out a good system.

The writer makes the following conservative estimate of the average cost of a contagious disease under the present system.

One person, at least, is thrown out of employment on account of every contagious disease—often several are obliged to remain from their work. Basing the estimate upon the assumption that this person can at least earn a common laborer's pay—one dollar and fifty cents a day—and that he will be compelled to lose this for two weeks or twelve working days, we find that he loses eighteen dollars from his earnings. Happy is he who escapes with a bill for a like sum for medical attendance: thirty-six dollars for lost time and the doctor. Now with medicines, nursing and articles destroyed, the sum is easily increased to fifty dollars. This altogether too conservative estimate places on the average the direct cost to the head of the family in which the sickness occurs, at fifty dollars, if the patient recovers. Indirectly, the cost may be vastly more than this.

The comparison of the origin and spread of these diseases to a fire is old, but appropriate.

It will be practically impossible to prevent isolated cases now and then occurring until bacteriologists have taught us more concerning the micro-organisms that cause them, and every city and town has adopted the same stringent regulations and makes sure that they are carried out in detail.

Then, when from an isolated case the disease spreads and other cases occur, some one will be responsible, as all great epidemics, like great conflagrations, usually begin with such small proportions that almost any well-directed effort to subdue them at an early stage, would be successful.

Health departments should be as well or better equipped than fire departments: as when a flame is quenched, no matter how great the threatened peril at first, the danger is gone; with the alarms the health department receives, the danger only begins; the flame burns constantly for weeks, and is liable to break out with renewed vigor at any moment, until the patient has recovered, and every article which may have been in the least infected, has been disinfected.

Thus for a long time does one single case of a contagious disease require constant vigilance. All cities maintain, at great expense, well equipped fire departments. Why not have the health department as well equipped? So that when a physician is called to see a sick person and makes a diagnosis of a contagious disease, he may immediately notify the health authorities, who have a representative constantly

ready to respond at once to the call. This person, without delay, visits the place, and if he is convinced that the patient can be isolated at home so as to expose none but the necessary attendants, let him remain there, but the portion of the house not used for the sick person's care should at once be disinfected. The responsibility of the health authorities should not end until the patient has recovered and everything has been disinfected. Until then, they should have personal knowledge that their rules and regulations are being fully complied with. If, on the other hand, as in the majority of cases, is likely to happen, it is found that the sick one cannot be completely isolated, or that from any cause, others may be endangered, the ambulance should at once be summoned and the patient removed to the hospital, and at the same time all articles which have been subjected to infection, and can be transported, should be taken to the disinfecting plant and sterilized. These can be returned within twenty-four hours, or as soon as the house is ready to receive them.

When the sick person and infected articles have been removed, a corps of trained and reliable assistants should immediately cleanse, with disinfecting solutions, any room or portion of the house which could possibly in the future be a source of danger. As soon as all this is accomplished, the bread-winners of the family could pursue their usual avocations.

This plan when put to the test, may need modifications, but in the main could be carried out. The expense which, upon first thought, would seem to be very great, would not be so large as to render it impracticable, as after the plant was once established, the number of persons constantly employed, would be small. In times of need, outside help could be secured.

Undoubtedly many lives are sacrificed by contagious diseases yearly, that could be saved if all persons would conscientiously give attention to details, and lend their support both morally and financially.

SOME REMARKS ON ETIOLOGIE AND PROPHYLAXIS OF THE TRANSMISSIBLE DISEASES.

By Dr. J. E. MONJARÁS, San Luis Potosi, Mexico.

At the request of the Chairman of the Committee on "The Causes and Prevention of Infectious Diseases," of which I have the honor to form a part, I beg to offer a few remarks on my experience with transmissible diseases which I have been able to obtain in the city of San Luis Potosí, where I practice my profession. This city has a population of 68,790 inhabitants, as shown by the census returns which I annex; it is situated at an elevation of 1,899 metres above sea level and 95 kilometres from the Tropic of Cancer. In the data I now present in detail, I have taken advantage of the information derived through some slight epidemics of small-pox, scarlatina, diphtheria and exanthematic typhus, which were noted during the year from October, 1898, to September, 1899, in connection with the meteorological observations for the same period.

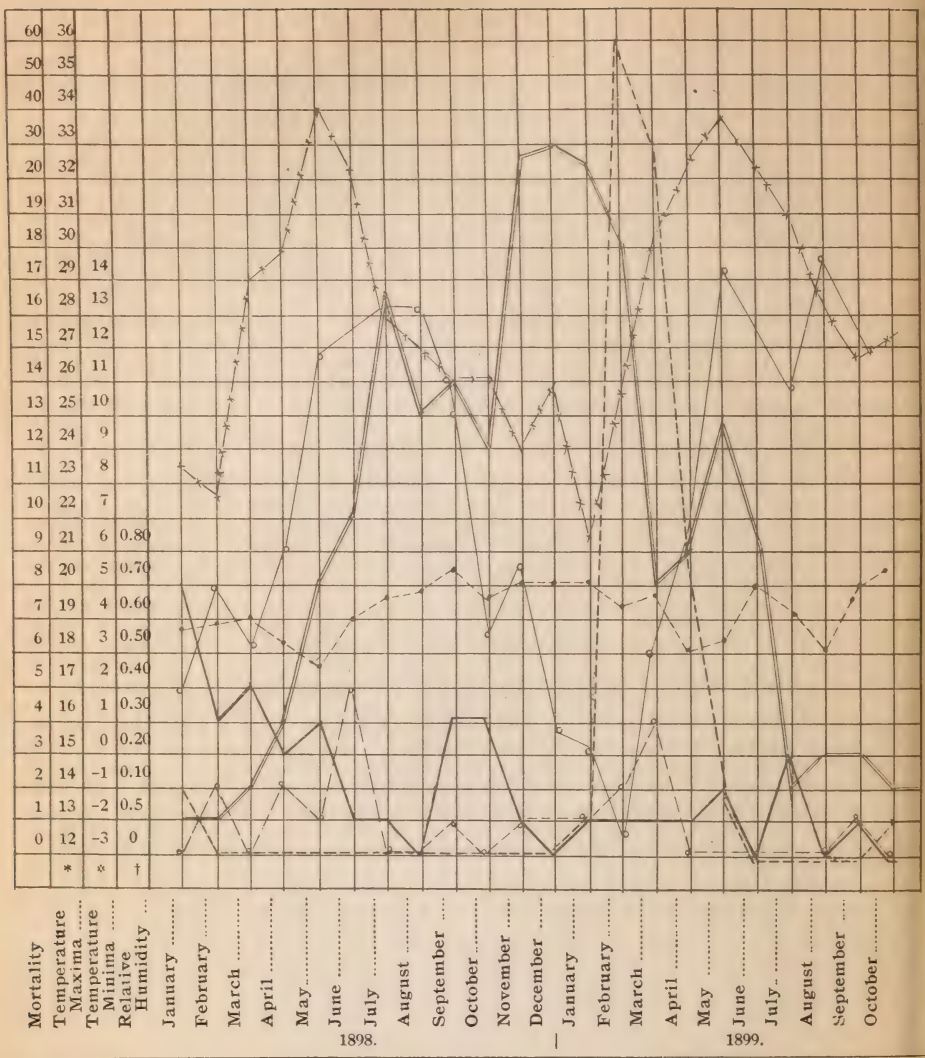
DETERMINING SPECIFIC CAUSE.

The study of these statistical data, in connection with the meteorological observations, the social position and occupation of the patient, etc., again shows us that the development of these diseases is attributable to a multitude of factors, whose individual action we hardly begin to understand. They cannot be attributed exclusively to the contact of specific germs with our tissues, because, as clearly shown by the course of the cases as they appear, if the direct or indirect contagion has been evident in some of these cases, the same thing cannot be said of the majority, as their records do not show that they have been in contact with any diseased person or object.

In order to determine this point, I have taken care to indicate each case with a colored pin on the plan of the city, showing the nature of the disease, in such a manner that each case was shown as soon as it appeared, with the nature of the transmissible disease, and thus I was able to observe its spread in the different quarters of the city.

Besides this, I have kept a detailed record of each case, showing the following data:

1. Notice to the sanitary authorities, with particulars of the sick man and the disease.
2. Notice to the owner of the house of the visit of the inspector of disinfection, for the purpose of examining its hygienic condition.
3. Record of technical service, bulletin of sanitary investigation.



Typhus .....

Smallpox .....

Diphtheria .....

LaGrippe .....

Maxima .....

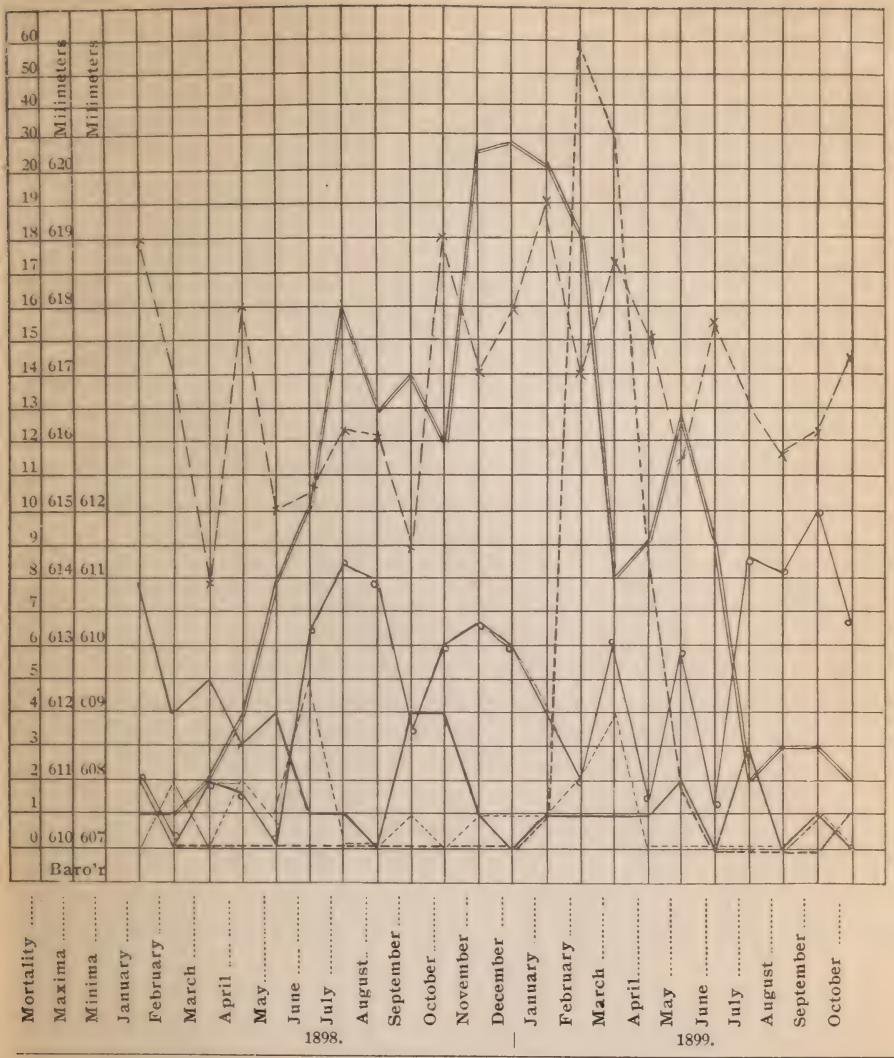
Minima .....

Humidity .....

* Celsius.

† Pluviometer.

Diagram showing the mortality from Typhus, Smallpox, Diphtheria and LaGrippe in the City of St. Louis Potosi, Mexico, in relation with the maxima and minima temperatures and relative humidity of the air by the rain fall in 22 months, from the 1st of January, 1898, till the 31st of October, 1899.



Typhus .....

Smallpox .....

Diphtheria ....

LaGrippe.....

Maxima .....

Minima .....

Diagram showing the mortality from Typhus, Smallpox, Diphtheria and LaGrippe in the City of St. Louis Potosi, Mexico, in relation with the pressure of the air maxima and minima in 22 months from the 1st of January, 1898, until the 31st of October, 1899.

4. Notice to the proprietor of the sanitary work which he has to execute in the house.

5. Notice of disinfection.

6. Certificate of death.

These observations perfectly agree with the experiments I have lately made relating to the indifference of our system to the action of the pathogenic microbes which constantly exist in the atmosphere that surrounds us, in the digestive tube, on the surface of the skin, in the cavity of the mouth, etc. The memorable experiments of Bouchard, who, without causing any lesion and consequently without any direct contagion obtained the rapid appearance of microbes in the blood of healthy animals, by submitting them to the same causes that favor the development of infectious diseases, which are called spontaneous in mankind, prove that they are caused by microbes which inhabit these cavities, and which remain there in an inoffensive condition, up to the moment when some very slight cause renders it possible for them to penetrate and circulate through the tissues.

Another interesting proof is to be found in our knowledge of the services rendered by the cell as agent of the disease or defender of the system under conditions whose specification could be indefinitely extended and in which it would be useless for us to look for the participation of a single microbe. In this connection we must not overlook the importance of the antitoxic plasmas which at any given moment present a strong opposition to the effects of the bacterian products.

For these reasons, it is not entirely necessary to go far in search of the morbific element, which is always in the immediate neighborhood and introduces itself at the moment when the watchfulness of the system is in any way weakened; whenever any one of the means of defence with which it is furnished allows itself to be surprised and does not oppose the invasion of the system by the typical element or its toxines, which are the powerful arms that it employs.

We must therefore give less credit to the influence of contagion in the development of transmissible diseases and modify our present explanation thereof, which gives such a great importance to the contact of pathogenic microbes with the system, as we have seen that in most cases this contact is entirely innocuous.

For us the contagion arises not when the microbe comes in contact with the surface of our tissues, but when it commences to flourish inside of them, giving rise to the development of a culture, that, at first, is strictly local.

EXISTING CAUSE.

By a study of the influence exercised by the thermal variations, the pressure, humidity, etc., in the appearance and spread of these diseases,

we find that they are as intimately related to the meteorological phenomena, as has been observed since the time of Hippocrates.

Recent observations have clearly shown us that, in the above cases, the physical element has not carried a microbe from outside, nor has it produced the solution of continuity by which one of the known bacteria could penetrate; but that it debilitated the defences of the system and permitted the development of them.

Experiments have not as yet been made under the exact conditions, which would, with any degree of certainty, bring about in man that series of phenomena which would show the exact degree of influence of each one of these factors.

Unquestionably, the difficulties have been largely increased by the susceptibility of man to these cosmic influences and the great difficulty which the experimenter encounters in bringing them under the same conditions that are found in nature, and to carry out the experiments under any one of these conditions by itself, as has been done by some, is not by any means the same thing.

These considerations are supported by the surprising results that were obtained by Prof. D'Arsona with his celebrated experiments in physical biology of animals. Our knowledge of electrical oscillations has brought us to a knowledge of their great power, a power that, on account of its frequency, of its action on the oxygen consumed, on CO_2 produced and the pressure on nutrition, etc., realizes the illusion of the vital fluid. This similarity is all the more legitimate seeing that these oscillations intervene, like this fluid without affecting the general sensibility or, so to speak, without the economy of the system having any knowledge of its manifestation. This is an experiment whose ingenuity and importance are at once understood, and it consists in placing a frog in a magnetic field of considerable intensity, and in observing the modifications that take place in its circulation without anything visible or tangible or surprising taking any effect whatever upon the animal.

As can be seen, notwithstanding the difficulties encountered in the investigations that are undertaken in this direction, it is possible, relying on the results of these experiments in animals, to scientifically demonstrate an intimate relation between the disease and these occasional causes which are called secondary by the epidemologists, especially if we take into account the office of the cell considered in its functions, secretions and relation to the external agents, such as cold, heat, electricity, etc. When the doctrines of infection were first brought forward, obfuscated by the influence of the germ, the authors of this doctrine almost overlooked the part played by the soil in which it is developed, notwithstanding that since that date the classical experience of Ranlin and the farsighted teaching of Prof. Bouchard,

clearly show that to-day we restore what belongs to it. Well, now, this soil, and its variations specially correspond to the cell and its manifestations.

In fact, we cannot entirely separate a body in state of activity such as the cell, from its surrounding atmosphere without endangering the phenomena of its life, or vitiate these conditions without injuring the system of which it forms a part, its activity producing certain products, as has been demonstrated by Hallopeau and Gautier in Moscow.

The causes that may influence the cellular activity and determine the appearance of toxic substances in the system can evidently, as well proved by H. Boucher, only proceed from two sources; either from the system itself, which alter its nutrition, according to the conditions of strength or weakness in which it finds itself, or else from the outside matter in which it moves, and by which it is surrounded on every side and whose qualities produce an incessant variation.

It is therefore in these media, so variable in their composition, where the specific determining causes find that principal co-operation without which the other causes generally are left impotent for the development and spread of transmissible diseases. It is in the extensive variations of the environment that we must look for the mechanism that presides over the appearance of the infectious principle.

Whenever, under the influence of the seasons variations are produced in the composition of the surrounding atmosphere by cold, heat or pressure of the electro-magnetic forces that are there found the cohesive properties of the tissues become torpid, and the live cell suffering a special impression through these variations, loses part of that energy which is so necessary to its normal action and the bactericidal power of its plasmas diminishes, its normal secretions are modified and become abnormal, so that either in a spontaneous manner or excited by the typical pathogenic agents by which it is directly or indirectly influenced it produces the toxines that are referred to by Hallopeau or the fermentations discovered by Bard in 1895.

Here we have the way in which these physical and cosmic causes act whose etiological effect no one can deny and to whose powerful action we must accustom our system by physical exercise in the open air so as to get the benefits of its healthy influence, and feel certain that the contact of the bacteria, whether pathogenic or not will be innocuous.

PERIODS OF INCUBATION AND CIRCUMSTANCES AFFECTING THE PERIOD.

In the group of transmissible diseases that we have observed during the year above referred to, we have not been able to find that the period of incubation has generally suffered any variation that could be noted, as regards the recognized normal type.

The circumstance that might have affected that period in some of them was, unquestionably, the simultaneous appearance of influenza, which has come to fill the double office of predisposing, and at the same time determining, cause, giving rise to those serious infections by association, which develop with astonishing rapidity; bronchitis and pneumonia of an infectious character appear here and there, and at the same time, influenza, in all its many different forms, as well as all degradations of angina, from the simplest form up to the diphtheric, including the inflammatory and hepatic symptoms.

VARIATIONS IN TYPE OF THE INFECTIONS, ATTENUATION AND INCREASE OF VIRULENCE.

The type of some of the infections that have been observed has been modified by the influenza, when the latter has developed at the same time. In the bacteriological inspections of the secretions of all patients who enter the hospital of the city, which were systematically carried out, we found in almost all the cases of broncho-pulmonary affections the microbic organisms of influenza, the symptoms and progress of these diseases were modified under the influence of the latter affection.

Once again we have been able to observe the immunity which is enjoyed by adults with respect to certain virus such as that of diphtheria. A study of the ages of persons attacked by this disease shows us that a few of them were adults, and the same thing has been observed in all the epidemics that have invaded this city. This immunity may be attributed to specialties of our race or to the attenuation which the virus has suffered through the conditions of climate and altitude in those cities which, like San Luis Potosí, are situated at an elevation of 6000 feet above sea level.

This last hypothesis is supported by the special fact that the colored cultivations which I brought from Europe and from U. S. A. to this country lose their coloring power but preserve their purity notwithstanding their being in due time renewed.

The small-pox has presented some variations from the type with which it had presented itself up to now. Every well vaccinated individual, even though he was only vaccinated once, enjoyed a perpetual immunity, and nevertheless amongst those who were attacked by the epidemic of 1898 and 1899, we found some cases that, in spite of the evident scars of a perfect vaccination, were attacked by this terrible disease and in some cases died. Must we conclude that the virus acted with a force that was superior to that which it had hitherto exercised or that the system had become so debilitated that the same pathogenic agent could produce a greater effect?

MEASURES FOR PREVENTING THE SPREAD OF THE INFECTIOUS DISEASES.

The system can rely on the cutaneous and mucous surfaces to defend it in an efficacious manner against the action of pathogenic agents. In these parts which, according to the idea of Bernard, continue to form part of the outside world, these specific germs can habitually live without causing any injury whatever, and those surfaces also have a series of protectors which, at the proper time, oppose the entry of the pathogenic agents into the closed regions. They also possess means of defence that come into action whenever those agents have been able to penetrate the first line of defence and introduce themselves into the interior of the tissues; and in one word, they have means to neutralize the damage of the invasion whenever it has taken place.

A knowledge of the pathogenic agent, of the mechanism by which it penetrates and works inside of our tissues or by which it develops there; of the circumstances that strengthen or debilitate it; of the means of defence on which the system can rely for the destruction, or neutralization, of those germs, is the indispensable condition that will enable us to employ a rational system of therapeutics in the course of transmissible diseases.

In the commencement of bacteriological discoveries, as always happens when at the commencement of biological investigations, experiments are not utilized, and we only rest on the senses or instinct and very seldom on reason. It was then supposed that every disease had its specific germ which constantly proceeded from the surrounding atmosphere; a germ whose different attributes, imparted to the disease its especial character. We now know what became of these simple and premature assertions. The number of specific microbes which generate diseases that are similar amongst themselves is every day more restricted; but on the other hand the saprophytes, the common ones, have acquired an unexpected importance. Every day we see a greater possibility of a single one of these elements creating different affections and engendering either a mortal disease or immunity, as shown by the experiments of Charrin and Roget with the pyocyanic bacillus.

All these well established facts have necessarily modified the first opinions, and to these we must add the well directed investigations with regard to other bacilli such as the colon proved by the experiments of A. Lamaire with his two bacili A and V, which show themselves to be so different in their effects: A produces only a local infection whilst V produces only a general infection, and nevertheless they are two types of the colon bacillus which is developed in colonies of a similar character in the different cultures, accompany the glycose,

producing gas, make the indol and are both agglutinized by the anti-colibacilar serum of the horse. A is a bacillus with only a slight movement; V on the other hand has a very active movement, and in one word they are similar when cultivated *in vitro*, and different when cultivated in an animal.

If to these well investigated facts we add what has been above said respecting the important office of the cell in matters of infection, the strong influence of toxines, which may either bring on the most serious disorders or the most surprising refractory conditions; which may either create lesions or lead to sero therapy, the above remarks as to the powerful influence exercised by these small organisms, the external medium in which they circulate and the organism which they inhabit, enable us to assert that outside of the cases in which the energy of the cause is excessive and out of proportion to the means of resistance, no typical, physical, liquid or psychic agent can rise to the dignity of an etiological factor, if it does not first deteriorate the cell, either in its structure, in its functions or in its secretions. It is therefore indispensably necessary that a previous influence should have debiliated this powerful element of defence before the infectious disease can acquire any development.

LEGAL AND SANITARY MEASURES FOR PREVENTING THE SPREAD OF THE DISEASES.

Now when we have a better understanding of the etiological and prophylactic effects of the secondary and occasional causes as well as of the methods by which they bring on the infection, it becomes the duty of the proper authorities to revise the sanitary regulations and to bring them in line with those principles which science every day reveals and which are taught by scientific associations like ours. It is also the duty of the physicians who attend such patients to teach them the practical steps which they ought to employ for the good of the victims themselves and in the interest of the community in which they form a part.

These measures are as follows: Obligatory vaccination. Obligatory declaration of every case of transmissible disease, notwithstanding the obligations of professional secrecy. The obligatory disinfection of houses, even sacrificing the inviolable rights of the domicile.

It is very important to obtain a prompt diagnosis of the suspected case, by a microscopical examination, and in the same way ascertain the moment that they can be allowed to return to society without any danger.

Another important point is to watch over the means of communication, not by establishing quarantines which are really foci of disease

but by means of special national and international establishments which will allow the passenger to be properly examined with the least possible inconvenience to himself.

With respect to those individuals who have enjoyed immunity although exposed to the disease, they should strictly observe hygienic rules; avoid all excesses; give special attention to their personal cleanliness, keeping their mouths and digestive tubes in good order, carefully selecting their proper food, both solid and liquid; watch over the asepsis of their domestic utensils, and provide means for allowing the sun and air to have free access to the rooms for as long a time as possible. The greater number of the persons who were attacked during the epidemics I above refer to, had no knowledge whatever of either hygiene or comfort.

The capacity of resisting the cosmic agents is largely increased by the methodical physical training of the masses and by the regulation of physical exercises in the open air on the part of the pupils in the public school, soldiers, workmen and generally, all social groups.

The sanitation of the cities should be carried out at any cost as experience has shown that in those places where such elements of progress have been neglected epidemics were prolonged and at the same time more violent. Consider the difference between the cholera in Spain and in Paris of these last few years; the difference in the mortality before and after the sanitation of the city.

GENERAL THERAPEUTIC MEASURES.

Whilst we take all these precautions, we must also consider the general therapeutics that are to be employed in the cases of infectious disease. From the moment that it is shown that the bacteria or their soluble products sometimes produce a local before a general infection, it is natural to direct our first attack to those places which are invaded by the pathogenic agent, and to procure its destruction or neutralization by means of disinfection. We therefore have to disinfect the digestive tube in those diseases which have a colibacilar origin; the air passages in those affections which are brought on by the pneumococcus, etc. It is necessary to impart activity to the emunctories, the intestines, lungs, biliary channels, etc., by means of baths, friction or electricity. The functions of the liver should be facilitated as the special cells of the capillaries retain and distribute a large number of bacterian cells and transform a part of the poison (Lemaire Charrin.)

In cases of diphtheria, the treatment to be employed in preference over all others should be that of sero therapy with the Roux or Behring serum which gives surprising results infallible in the first three days and of great utility in the following days. It can also be employed as

a preventive. In the cases of exanthematic typhus, smallpox, grippe, it may be employed, although not with such good results, and besides what I have indicated, simple saline solutions are used which allow a washing of the blood and produce an increase in the sanguineous pressure increase the eliminations, facilitate the changes, the osmosis and the fermentation. We now begin to understand the reasons for these favorable effects founded on the importance of the saline elements in the structure or action of the fermentation.

TABLE SHOWING TOTAL DEATHS IN THE CITY OF SAN LUIS POTOSI, MEXICO, DURING THE TWELVE MONTHS BEGINNING OCTOBER 1st, 1898, AND ENDED SEPTEMBER 30th, 1899, CLASSIFIED ACCORDING TO THE SEX AND SOCIAL CONDITIONS OF THE PATIENTS.

	Men	Women	Total	Wealthy	Poor	Hosp'als
January	111	105	216	39	167	10
February	115	120	235	58	160	17
March	126	121	247	41	185	21
April	125	110	235	50	172	13
May	191	165	356	94	244	18
June	163	146	309	85	207	17
July	146	150	296	72	206	18
August	127	119	246	61	174	11
September	122	115	237	38	186	13
October	155	129	284	44	221	19
November	106	108	214	38	169	7
December	95	104	199	39	148	12
TOTALS	1582	1492	3074	659	2239	176

TABLE SHOWING THE MORTALITY FROM INFECTIOUS DISEASES IN THE CITY OF SAN LUIS POTOSI, MEXICO, DURING THE TWELVE MONTHS BEGINNING OCTOBER 1st, 1898 AND ENDED SEPTEMBER 30th, 1899, CLASSIFIED ACCORDING TO THE CAUSE, AGES, SEX AND SOCIAL CONDITION OF THE PATIENTS.

		CAUSES OF DEATH.	From 0 to 2 mo		From 3 to 11 mo		From 12 to 23 mo		From 2 to 4 yrs		From 5 to 19 yrs		From 20 to 39 yrs		From 40 to 59 yrs		60 and more yrs		Aggregation		Total	Wealthy	Poor	Hospitals
1	2	Typhus	..	..	..	..	..	..	..	..	1	1	4	4	4	..	1	..	10	5	15	7	5	3
...	3	Scurvy	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	1	.....	.....
...	4	Smallpox	4	5	17	22	3	2	13	15	32	31	7	6	..	..	..	..	76	81	157	21	130	6
...	5	Measles	..	..	1	1	..	..	..	1	..	..	..	..	..	..	..	..	1	2	3	.....	3	.....
...	6	Scarlet Fever	..	..	1	..	..	..	..	1	2	..	..	..	..	..	..	..	3	1	4	3	1	.....
...	7	Whooping Cough	..	..	6	5	..	1	2	2	2	1	..	..	..	1	..	..	10	9	19	.....	19	.....
...	8	Diphtheria and Croup	..	..	3	1	..	..	3	1	..	1	..	..	..	1	..	..	6	4	10	9	.....	1
...	9	Influenza	3	7	15	11	..	..	2	7	1	3	10	8	14	8	5	8	50	52	102	22	80	.....
...	12	Cholera Nostras	..	..	6	4	..	..	..	4	..	..	1	..	..	1	..	..	7	9	16	6	10	.....
...	13	Yellow Fever	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	1	..	1	.....	.....	1
...	14	Pyæmia and Septicæmia	..	1	..	..	..	..	..	..	2	..	..	1	..	..	2	..	4	2	6	2	2	2
...	16	Malignant Pustule	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	1	..	1	.....	.....	1
...	17	Rabies	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	1	..	1	.....	.....	1
...	19	Intermittent Fever	..	..	2	..	..	2	1	1	5	1	7	3	5	..	..	..	20	7	27	12	12	3
...	20	Malarial Cachexia	..	..	..	..	..	..	..	..	..	..	..	1	1	..	..	..	1	1	2	1	1	.....
...	22 A	Tuberculosis of the Lungs	..	..	..	..	..	..	..	2	8	5	29	31	12	10	5	4	54	52	106	47	40	19
...	22 B	" " " Meninges	..	..	1	2	1	..	1	..	2	..	..	..	..	..	..	..	5	2	7	4	3	.....
...	22 C	" " " Peritoneum	..	..	..	1	1	..	1	3	1	..	..	..	..	..	..	..	3	4	7	2	5	.....
...	22 E	" " other organs	..	..	..	1	..	..	..	..	1	..	3	1	1	3	..	..	5	5	10	7	3	.....
...	22 F	" General	..	..	1	..	..	..	..	..	3	3	2	1	1	2	..	1	7	7	14	7	5	2
...	23	Scrofula	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	1	..	1	.....	1	.....
...	24	Syphilis	1	1	1	..	..	..	..	..	..	..	1	1	2	..	..	..	5	2	7	5	.....	2
...	25 A	Cancer of the Mouth	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	..	1	1	.....	.....
...	25 B	" " " Stomach, Liver	..	..	..	..	..	..	..	..	..	..	1	1	2	2	1	2	4	5	9	4	5	.....
...	25 C	" " " Intestines, Rectum	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1	1	1	2	3	.....	2	1
...	25 D	" " " Female Genital Organs	..	..	..	..	..	..	..	..	..	..	..	2	..	6	..	4	...	12	12	5	7	.....
...	25 E	" " " Breast	..	..	..	..	..	..	..	..	..	..	..	2	..	2	..	..	...	4	4	3	1	.....
...	25 G	Others	..	..	..	..	..	..	..	1	..	1	..	1	3	1	..	..	3	4	7	3	2	2
		TOTALS	9	14	54	48	5	5	23	38	61	47	68	64	45	36	16	20	281	272	553	172	337	44

REPORT OF COMMITTEE ON INFANT MORTALITY.

By ERNEST WENDE, M. D., Chairman,
Health Commissioner, Buffalo, N. Y.

Were an apology necessary, for limiting our inquiry to the supervision and protection exercised by Municipal and State authorities over the dairy interests and milk business, sufficient excuse would be found in the mortality tables of the various health departments of cities, showing clearly that early infant mortality depends largely upon milk as a doubtful commodity. The importance of this subject is much greater than is commonly realized, for the mortality rate of every municipality is dependent upon the ratio of its infant mortality. Recently this fact has been more than emphasized in that these tables show encouragement in an unusual decrease in the death-rate of several large cities.

The nursing period is the most critical time in the life of an infant, and that passed, its chances for further existence are extremely favorable.

Yet milk is reputed to be a perfect and complete food. Nature has provided it for the young of the mammalia, and her choice might be trusted were it not for the insanitary and inhuman conditions which too frequently prevail at the dairy of the producer, at the milk-house of the dealer, and at the home of the consumer.

Too frequently, to impute the misfortunes to the agency of others, these centres of infection are carelessly sought for and overlooked by the political and incompetent health official.

Too frequently, the greedy and dishonest vendor, for keeping properties or to purify it in some mysterious way, adds a preservative or employs a disinfectant which acts as an irritant or poison to the milk-bibbing economy of the baby.

Again, too frequently, before reaching the nursery it becomes a mixed drink or an unsafe beverage of bacteria. The more milk, and the less the bacteria, the smaller the injury; the more the bacteria and the less the milk, the greater the injury inflicted. "Sin is a reproach to any people," say the scriptures—so is disease and death of the helpless, due to an unwholesome milk supply.

To ascertain the significance attached to this serious and momentous theme, and, moreover, with a desire to become better acquainted with the important details which govern the milk traffic existing in other cities, a circular letter, of which the subjoined is a copy, was caused to be mailed to the health authorities representing the one hundred largest cities in the United States.

"DEAR SIR—As Chairman of the 'American Public Health Association Committee on the Cause and Prevention of Infantile Mortality,' and for the purpose of obtaining data and other information pertinent to its functions, I have the honor to ask:

"What supervision and protection is exercised by Municipal and State authorities over the dairy interests and milk business in your city, and what is its scope?

"ERNEST WENDE, Chairman."

To this inquiry, forty-nine replies were received, which ran the entire gamut. Nine exercised no municipal control, five possessed a partial jurisdiction, while the remainder varied from an inefficient administration to the severest restrictions and regulations, therefore, as a result of this interpellation, your Committee on the Cause and Prevention of Infantile Mortality beg to submit the following report:

INFANTILE MORTALITY.

While milk is the food of the nursery par excellence, and constitutes a large portion of the dietary of young children and those of feeble digestion, it is, likewise, a recognized fact that, like no other article of food, it enjoys the heinous tendency of becoming unclean, infected, and dangerous, a defilement which occurs most speedily. There was no difference of opinion concerning this proverbial conclusion, and in the larger municipalities especially, more stringent and comprehensive measures are annually adopted, with a view of abolishing many of the conditions under which diseases had previously flourished attributable to this source.

All of our correspondents, who touched upon this proposition, are agreed that the mortality of infants under five years of age, and principally of those under one year, is being gradually reduced in proportion as the quality of the milk improves.

Alterations in quantity and quality were reviewed by several from a practical aspect, and, naturally, the conditions which entered were many, some of them controllable, others not.

Those which may be regulated are production, storage, transportation, and delivery, while those beyond control are mainly the vicissitudes if the seasons, and, frequently, a need of proper jurisdiction over outlying districts.

In Buffalo, a rigid supervision over the milk supply, for the past six years, has reduced the infantile mortality to such an extent, during the nursing period as to be marvelous in comparison with previous rates.

In order to fully appreciate the results, we have appended a detailed table of mortality statistics since 1890:

DEATHS IN BUFFALO, N. Y.

Year.	Total Deaths.	Age by Years.															Color.		Sex.		Social Relation.	
		Under 1 Year.	1 to 2.	2 to 3.	3 to 4.	4 to 5.	Total under 5 years.	5 to 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 and over	White.	Colored.	Male.	Female.	Married.	Single.
1890	5,024	1,630	386	132	86	71	2,305	149	64	97	396	435	356	362	389	471	4,987	37	2,731	2,290	1,961	3,063
1891	6,001	1,786	403	198	134	88	2,609	210	80	150	466	503	454	425	482	622	5,955	46	3,178	2,823	2,433	3,568
1892	5,697	1,699	441	190	152	77	2,559	205	75	133	497	504	357	396	453	518	5,653	44	3,079	2,618	2,130	3,567
1893	5,711	1,760	432	174	119	116	2,601	225	79	134	441	462	395	386	424	564	5,676	35	3,122	2,589	2,108	3,603
1894	5,280	1,454	455	161	109	70	2,249	227	82	138	445	452	410	351	370	556	5,233	47	2,323	2,457	1,980	3,300
1895	4,684	1,177	429	168	112	85	1,971	187	82	103	390	389	307	388	376	491	4,645	39	2,521	2,163	1,822	2,862
1896	4,452	1,072	394	160	102	65	1,793	180	65	115	385	381	352	307	392	508	4,416	36	2,319	2,133	1,801	2,651
1897	4,475	1,044	315	139	100	45	1,643	162	78	118	408	384	374	360	390	560	4,440	35	2,275	2,200	2,002	2,473
1898	4,533	1,130	263	92	54	31	1,570	112	69	131	382	417	386	395	439	632	4,503	30	2,392	2,141	2,178	2,355

By reference to this table, you will note that the greatest diminution in deaths occurred in children under five years of age, the larger percentage being in those under one year of age.

EDUCATING MOTHERS.

The laws of the State of New York require all births to be reported to the Bureau of Vital Statistics of the Deparement of Health, which gives an excellent opportunity to impart information to mothers at a time when it is mostly needed. Accordingly, the Buffalo Bureau of Vital Statistics causes a circular of instruction, on the care of infants, to be mailed to each household at the beginning of the heated period. That the result is marvelous is indicated by the table of mortality statistics submitted, as the greatest decrease is noted during the nursing period.

In 1890, out of a total of 5,024 deaths in Buffalo, 2,305 were under five years of age.

The births of Buffalo number about 10,000 annually, yet, in 1898, notwithstanding this great intermediate addition, there were only 1,570 deaths of children under five years, out of a total of 4,533 deaths of all ages. The continuous and marked decrease of infant mortality dates from the time these circulars were first distributed. In cholera infantum alone, the decrease in the death rate of children was over 100 per cent. Among the agents which materially assisted in the reduction was an ordinance prohibiting the sale of long-tubed nursing bottles.

These death-dealing nursery adjuncts have been effectually abolished in Buffalo, but not until after a struggle on the part of the trade.

It is gratifying to note that this, as well as some other Buffalo innovations, have, after comparison and consideration, been adopted by other municipalities and found to be equally efficient, simple and comprehensive.

DISEASES CONVEYED BY MILK.

We possess evidence, perfectly understood, gained by experience, bearing potentialities for evil, which are unbounded in the dissemination of the virus tuberculosis, diphtheria, scarlet and typhoid fevers, in the generation of toxic bacterial products giving rise to acute diarrhœa, cholera infantum, and tyrotoxicon poisoning, and in the production of inanition, malnutrition and marasmus, through the medium of an unwholesome milk supply.

Numerous records of such epidemics are at hand in which the spread of infection was definitely traced to the dairy and its surroundings, contracted from the mouth, nose, throat, skin and discharges of those in charge, and recently convalescent or scarcely recovered.

Thus the materies morbi, which is very tenacious of life, clings to the hands and clothes of the careless who, in turn, pollute the water, and then cause it to lodge into the cracks, crevices, seams and inequalities of the walls, floors and surfaces of the insanitary milk house, storage box, cans and bottles, there to thrive and multiply for the transmission to do infinite mischief, and the slaughter of the innocent.

Notable among these outbreaks, we may mention the 95, described and tabulated by Hart, of England, of which 48 were typhoid fever, 32 scarlet fever and 15 diphtheria, and the 90, collected and tabulated by Freeman, of this country, of which 53 were typhoid fever, 26 scarlet fever and 11 diphtheria.

To confirm, as well as for the purpose of supplementing these numerous instances of the spread of infection by an improper milk supply, five outbreaks, parallel in relationship, of which three were typhoid fever and two scarlet fever, that occurred in the city of Buffalo since 1893, may be profitably cited.

It was in the fall of this year that we encountered our first visitation of a contagious disease traceable to and rapidly extending through the instrumentality of a milk dealer's route. Here, likewise, the seeds of infection were brought to the persons unfortunate enough to come in contact with the contaminated milk from a remote centre, and, at the first opportunity, the individuals infected others and so the evil spread.

It was casually observed that a group of scarlet fever cases prevailed in such association that it was seemingly apparent, according to every reasonable expectation, that they all depended upon a like source of infection. An investigation was, at once, instituted, which revealed the fact that 57 children of 26 separate and distinct families had succumbed to scarlet fever, all of whom had procured their milk from the same milk man whose milk house, equipment, help and family were all scrutinized with the result of finding two cases in his immediate household.

Inasmuch as nothing could be discovered of an insanitary or causative nature with his own outfit, environment and mode of handling, the inquiry was further carried back to the source of milk production—the dairy farm—with the sequence of detecting two cases of scarlet fever, in the desquamating period, occurring respectively in a child aged seven and in a young man of nineteen.

The latter, who still had large flakes of cuticle pealing from the extremities, must be credited with his share of the misfortune, for devastation followed the wake of his labor.

It was he, before being thoroughly restored, ignorant of the danger caused by the stray particles of shed epidermis thickly peopled with the infective bacteria or their spores, that did the milking, washed the

cans and transported the commodity to the depot for shipment to be received and distributed to the unsuspicious consumer by the city milk dealer.

Here, then, the first demonstrative milk epidemic of scarlet fever in our midst showed a typical case.

The interesting and subjunctive corollary deduced from the research is convincing:

First. That all the facts, brought out by a persistent investigation of the epidemic, pointed to the milk supply.

Second. That the cases appeared almost simultaneously, extending rapidly, and attacking especially those who partook freely of the lacteal fluid.

Third. That only the homes located in a certain milk route were invaded, and those frequently having the best hygienic environments.

Fourth. That, happily, the wane of the epidemic was equally abrupt following the discontinuance of the mischievous product.

THE TELL-TALE MILK REGISTER.

Briefly, this is the unvarnished tale concerning our first recognized outbreak of scarlet fever caused by a contagious poison emanating from a doubtful milk supply. However, it shed much light upon the milk dealers' route as a channel for the dissemination of disease, and served as a stimulus, as well, to yet more carefully scrutinize and guard the milk traffic. The most important practical result of this inquiry was the devising and maintaining of a register of contagious diseases in connection with their occurrence upon these thoroughfares.

It is scarcely an exaggeration to say that the assigning of all acute infectious diseases, that arise in a municipality, to the milk man is an act consistent with the maintenance of health.

It means a system, feasible for daily surveillance, and effective in the protection against frequent infection of the milk consuming denizens.

Such a register is worthy of more than a passing notice. It stands as a silent guardian, watchful of the integrity of milk, the health and happiness of the home.

No department of health can be considered efficient, much less complete, without it.

This armementarium, when once adopted, will be the last to be dispensed with, for few things accomplish so much that are apparently so simple. Chemical analysis has a place; bacteriological tests another; but the register takes the place of all, in its importance and possibilities.

We may fairly attribute to this innovation the detection of the four subsequent epidemics in their incipiency. It made immediate investigation and the prevention of the further spread possible.

This invention, which had its birth in the Department of Health of Buffalo, immediately furnishes a ready and effectual means for the detection of infection on milk dealers' routes. Appreciating its merits, it is posted daily, and thus the healthfulness of the families, supplied by each individual dealer, is constantly watched. As soon as it appears that, on the route of any milk dealer, infectious disease exists, an immediate investigation is made into every detail of his business, source of supply, and the conditions existing there, when, if justification asserts itself, or even a doubt, his route is suspended, until it can be made absolute that his is not the source of danger.

We cannot be too thankful for this result, and we ought not to neglect its obvious lessons. In city milk routes, much remains to be done, in order to bring the sanitary conditions to a level with our knowledge. We cannot plead ignorance; apathy and indifference are the foes to be most dreaded.

On September 4th, 1894, we were assured, by the records of the register, that nineteen cases of typhoid fever had developed with wonderful rapidity in families served by a milk man living in a sparsely settled section of the northern portion of the city.

The health department, forthwith, instituted an investigation which showed the startling result that the wife of the milk man, surrounded by unfavorable conditions, was ill with the fever, however, on the borderland of recovery.

She was still being nursed and cared for by the husband who, likewise, was handling the milk, and washing the cans in a most objectionable manner, with water procured from an old cistern that had, during the preceding year, been the subject of several sanitary complaints.

Another powerful factor that made the transmission of the disease, through the medium of the milk imminently capable, was the fact that the patient was not isolated but cooped up in a small stuffy chamber adjoining the kitchen in direct communication with the milk room.

It is hardly necessary to state that the sale of the milk was interdicted; the cistern ordered abandoned, disinfected and filled, and everything pertaining to the dairy and the premises in general placed in a sanitary condition.

By this, and other procedures, the spread of the disease was checked, no further cases occurring upon the route.

On August 21st, 1895, the department, again, through the intervention of the register, discovered eighteen cases of typhoid fever intimately associated with the milk route of a dairyman located on the outskirts of the city.

An inquiry into the causes and circumstances of the outbreak revealed that his premises were not what they should be, by reason of defective drainage, and a badly constructed, ill-ventilated, and unclean

milk house, conditions, as might be expected, most favorable for the reception and multiplication of the typhoid bacillus.

The peculiar interest connected with these cases was that the wife of an employee had propagated the infection that had contaminated the milk through the agency of her husband who, at night, not only acted as nurse, but fulfilled the other necessary household duties, and who, during the day, handled and delivered the needed product to the confiding consumers, without changing his clothing for days, or taking any precaution whatever.

The sick wife was immediately removed to the hospital and the insanitary conditions so promptly changed that, by August 30th, just nine days after the discovery of the first, no further cases were reported.

Again, on March 9th, 1896, the register indicated the existence of fourteen cases affected with typhoid on the route of a milk man residing in the western portion of the city.

Here, we acquired the information that the milk room was in the rear of the first floor of the building which he occupied.

Several months previous, a case of typhoid developed on the floor above, in a separate family, and ran its full course.

These cases undoubtedly arose in consequence of the insanitary conditions prevalent in and about the building, and, for like reason, the contagion remained active until finding expression in the dairyman's route.

A quick subsidence of the epidemic followed, on the suppression of the milk, thorough cleansing and disinfection.

On February 27th, 1899, in consequence of the rapid development of scarlet fever—some twenty cases within four days—an investigation was made, and the source of the trouble traced to a dairy farm near Clarence, N. Y., twenty miles from the city, from where the milk supply was received.

It was ascertained that, at this place, four persons were infected with scarlet fever, one of whom, a convalescent, was, through ignorance of the danger and possibility of his acts, engaged in milking the cows, handling the cans and utensils.

Action was taken, at once, to prevent further injury from the milk, with the result of arresting the further development of cases by March 15th, when but four cases were reported. No further cases were then reported till April 4th, 1899, when we received reports of two additional cases, these being the last.

No better illustration could be found to demonstrate the condition liable to develop in any section in the present state of affairs—nor to demonstrate the value of this—the sanitary tell-tale or milk register.

In Buffalo, since these methods have been in vogue, there has been a decided fall in the mortality ratio of cholera infantum, scarlet fever,

diphtheria and typhoid fever, in spite of her enormous increase in population. The accompanying table is self-explanatory:

DEATHS FROM DISEASES WHICH ARE FREQUENTLY MILK-BORN.

Year.	Population.	Cholera Infantum.	Scarlet Fever.	Diphtheria	Typhoid Fever.
1890	260,000	348	21	111	105
1891	255,664	381	67	165	129
1892	285,000	376	84	177	98
1893	300,000	568	133	149	112
1894	315,000	417	85	214	185
1895	335,709	372	22	242	98
1896	350,000	321	14	249	68
1897	360,000	277	21	198	69
1898	370,000	254	13	85	98

MILK LEGISLATION.

Every American, realizing the splendid aspirations and the possibilities of the sanitarian, should take an interest in milk legislation, for the probable results of laws obtained from the State giving plenary powers to the health authorities in matters of municipal sanitation would be its eventual adoption by every civilized nation. It is of vital importance to all educated persons, not only individually, but also as members of the community, in order that there may be aroused in some minds the necessity of becoming better acquainted with the important details of the milk business.

The visitation of an epidemic should not be so readily forgotten.

For some time, legislation affecting agricultural interests has been jealously guarded by the farmer. Especially is this the case with such measures as relate to dairy products. Too much attention is paid to the commercial side of the question, and, judging from the reports received, this appears to have influenced some of the courts, as indicated by their rulings. It seems almost incredible that pecuniary loss should be given preference in the consideration of a question where human life is in the balance. If existing laws are inadequate or inefficient, they should be immediately remidied. If, then, they are not properly enforced, the blame must rest with health authorities who can appeal any

case and carry it to the highest court without loss to themselves, if they deem the case improperly disposed of by any of the trial courts.

JURISDICTION OF LOCAL AUTHORITIES.

This question has been variously considered and variously decided. However, the prevailing views held appear to be that the jurisdiction should be confined within the limits where the consumer resides or consumption takes place.

Some States have no dairy laws, and, even where these do exist, their enforcement under State supervision is usually unsatisfactory. Each city can be better trusted to more zealously look after the health of its own inhabitants than if taken care of by officials whose interests are divided and whose duties exceed their physical abilities.

The District of Columbia exercises supervision over the dairy interests as far beyond its confines at its market extends, and, apparently, this authority has never been questioned. Kansas City, as well as several other cities from which we have reports, do likewise.

Dairies, located beyond the city limits where they propose to sell milk, together with their herds, may be inspected in the same manner as those within the confines of the city, and a satisfactory certificate is given, or the application to transport milk to that city is denied, as warranted by the result of an investigation.

In some instances the expense is borne by the city ordering the inspection, while in others a fee is charged from the proprietor of the dairy so inspected, and the license granted is for a specific period.

Should conditions arise rendering it desirable or necessary to prevent the sale of milk from any dairy, the certificate, license or permit can be revoked at any time.

No person should be permitted to ship milk into any city without a milk-importers' permit, which should only be issued after a careful inspection of the premises and cattle. Before a milk-importers' permit is issued, a written application should be filed with the Board of Health of the city where it is intended to ship the commodity, such application giving a detailed statement—on blanks furnished for the purpose—of the location and condition of the premises, barns, stables, pastures, food, water supply, number of cows, and a sworn statement from a legally qualified veterinarian as to the condition of the herds. The application should also state facilities and method of caring for the milk until time of shipment, manner of transportation, and city milk vendor to whom milk is consigned. In some—or perhaps most cases—this may be sufficient, while, if the question of authority is raised, it can speedily and effectively be disposed of by interdicting the milk at the city line or at the depot, thus preventing its sale within the confines

of the city. Commercial interests would soon necessitate a compliance with all such paramount and reasonable demands.

DAIRIES, DAIRY FARMS AND COW-SHEDS.

Every municipality should inaugurate a code of rules and regulations for the thorough and systematic inspection of all dairies and cow-sheds.

The supervision should be rigid, and performed by an adequate and capable corps of inspectors. All places where milk is sold as the principal business, either over the counter or from vehicles, should be regarded as dairies; all places where milk is produced should be regarded as dairy farms.

Before granting a permit to engage in the business, the dairy and the premises in all its quarters upon which it is located should be thoroughly inspected to sufficiently insure a freedom of all vicious and insanitary conditions which always implies neglect or ignorance, and also with the ultimate object of affording ample protection to the milk-consuming denizens against the frequent infection of milk-borne diseases.

It is much easier to refuse a license before all specified requirements are complied with than to enforce a compliance thereafter.

When a building has been properly constructed and equipped for the event, and the dealer made familiar with the imperative necessities for its continuance, it is reasonable to assume that there will be less friction than if he received his instructions bit by bit and under easier sail. Nevertheless, rigid and frequent inspection at irregular intervals are prerequisite, to guard against any negligence or laxity, and any wilful violation of the prescribed rules should be met by a revocation of the license, and such other penalty as the case demands.

Again, should a dealer desire to remove to some other location, he should first make application to the health authorities for an inspection of said premises to determine whether they may be used for dairy purposes, and then make such alterations and sanitary improvements as are suggested by the inspector. Failure to comply should mean revocation of his license.

TUBERCULIN TEST.

Of the transmission of tuberculosis by milk, or the degree to which the milk of tuberculous cows is fit for consumption, there is some honest difference of opinion. Some hold that it is only infective when it comes from a tuberculous udder. In view of the practical difficulties in the way of deciding whether the udder disease is tuberculous or not, it is advisable to destroy the milk of any cow with any suspicious affec-

tion of that part. It is also safer not to use the milk of a tuberculous cow, even when no udder disease can be found.

A horse infected with glanders, or a dog with rabies, for the well-being of the public, and safety of other animals, is immediately made way with, but a cow, with tuberculosis well established, is allowed to linger, no matter whether life be in jeopardy or not, until someone pays full value for her morbid carcass.

Although it is conceded that there is infinitely more risk from the latter than from the former, and that the deadly effects of tuberculous milch cows are far more extensive, yet it is practically impossible to procure adequate legislation, and even where secured it has been rendered ineffective, either through inappropriate means of enforcement, or through the pecuniary indemnity clause. Therefore, it would seem that tuberculosis, from its communicability and identity in man and the lower animals, its enormous mortality, and the methods of dissemination, with equally accurate knowledge as to the methods which could restrict its prevalence, directs criticism to what is largely left undone by the State, whose attitude, in general, is one of negligence or indifference. Whatever legislation there may be on this subject, or in the absence of any specific legislation in any city or State, it is our opinion that the rigid enforcement of this matter lays largely, if not entirely, with the local health authorities.

To illustrate, the Department of Health of the City of Buffalo, probably not exactly in deference to its State law, which requires a compensation for tuberculous animals destroyed, directs all producers to furnish certificates of inspection by a competent veterinary surgeon, specifying the physical examination and tuberculin test of their herds.

Naturally, this, at once, raised the protest as to who should pay for such inspections and the cost of animals destroyed, and likewise, as a result of condemnation, the point that the city could exercise no jurisdiction beyond its limits. The question of jurisdiction was not entertained for a moment, but promptly disposed of by ruling that the sale of milk, from cows not capable of showing a clean bill of health, would be prohibited. The dairymen soon discovered that it was much easier to secure the required certificate than to contest a vexed question which they would lose eventually besides the possibility of being barred to sell their product within the domains of the city. In the City of New York, the same proposition has been handled in a similar manner.

This is so admirably discussed by the Secretary of the New York Department of Health, in his reply to the committee, that we quote his letter in full, as follows:

"The method of milk inspection adopted and enforced by the department to insure a pure milk supply to our citizens has been brought, to

what is almost a maximum degree of efficiency, as far as adulteration is concerned. The next important step to take was to prevent the sale and use of milk from diseased animals, and this, of course, could be done only to a limited extent, as the greater part of our milk supply comes from localities over which this department has no jurisdiction.

To attempt to determine from the milk alone, as brought into the city, whether the animals producing it were healthy, is impossible, even if a daily examination could be made; the only practical and sure method being to examine the animals themselves. Within our city limits, however, quite a number of cows (about 3,200) are kept, either to supply milk to the owners, or for sale to the public.

The disease most to be feared, from the fact of its ready transmittance to man, was tuberculosis, and to the detection of this disease, more especially, have the efforts of the department been directed, for it seems to be generally conceded by those who have made the subject of tuberculosis a study, that the following facts are not to be controverted:

First. That of all diseases that affect mankind tuberculosis is the most prevalent, is the cause of a greater mortality and is on the increase.

In our own city, the deaths from tuberculosis during the past ten years was 61,155, and it is estimated that of the entire number of deaths from all causes throughout the world 14 per cent. are due to tuberculosis.

Second. Tuberculosis in cattle is exactly the same disease as found in man, and is, of course, propagated and transmitted in a precisely similar manner.

Third. A large proportion of all milch cows are affected with this disease, and while it is difficult to give the absolute percentage of those so diseased, from the fact that the study and investigation of this subject is comparatively recent, still it is universally acknowledged that the prevalence is great.

In our own state, out of 2,147 cows examined, 405 were condemned; but from certain data obtained by the New York State Commissioners on tuberculosis in cattle, 6.93 per cent. was believed to be about the true percentage of tuberculous cows in New York State.

To diagnose surely and rapidly this disease in milch cows has, until the past few years, been almost impossible. Now, however, the discovery and perfection of the so-called "tuberculin test" enables us to do this.

In every case the tuberculin test has been fully confirmed by the autopsy. This is due to the fact that great care and judgment has been exercised. For it is obvious that to err and pronounce a diseased cow

as healthy is as bad, if not worse, than to pronounce a healthy cow diseased. In the first, a diseased cow remains in the herd to eventually infect others.

The result of this work has been to prevent the sale of diseased cows in the city, for all that are now sold are not paid for until the cows are examined by the department; and this fact necessitates the notification of this department that the cows in question have not been examined, insuring that no cows not examined and perhaps diseased are brought in contact with healthy animals."

The rules of the State Live Stock Sanitary Board of Pennsylvania provides for the inspection of suspected tuberculous cattle, upon application by owners of herds, at the expense of the state, while, on the other hand, the holder of dairy herds must bear the ransom imposed, and those found to be infected are ordered segregated from those that are healthy, and disposed of in accordance with the regulations of said board. The rules further provide that the stables must be disinfected, and faulty sanitary conditions corrected.

The Superintendent of the Bureau of Health of Pittsburg states that "The work of the Live Stock Sanitary Board is principally confined to the examination of cattle for evidence of tuberculosis, and the condemnation and destruction of such as are found to be infected. In this work, it has been greatly hampered by reason of *insufficient appropriations,* and also, perhaps, *by lack of proper authority.*"

CARE AND FOOD OF COWS.

Naturally, the care of an animal maintains an influence upon its health, and the sequence that an unhealthy cow must produce unhealthy milk. How is the consumer, who is mostly concerned, to appreciate and conceive this state of affairs?

Necessarily, he looks to the authorities for an effective responsibility to compel the dairyman to furnish him with a pure and wholesome milk. This can only be accomplished by the State exercising its functions in inspection, supervision under license, with appropriate penalties for infringements.

Stables should contain a sufficiet amount of air space, constructed with special reference to ventilating, light and of non-absorbent material, to permit sanitary cleansing.

Preferably, the milking should be done under cleanly auspices, in a compartment separate from the stable, which would insure non-contamination from stable filth. In milking, milk should be protected by washing the udders, "aproning the cows," and to insure personal cleanliness, uniforming the employees and giving them ample facilities for washing.

With properly constructed buildings, excreta can be promptly removed, and contamination of walls, floors and other parts prevented with such ease that there can be no excuse nor difficulty in maintaining a degree of cleanliness and protection.

The relationship between cow-food and the milk product has been closely studied, and if the well-known conclusions are followed, the cow can be depended upon to do her duty in complying with the requirements of the State standard. With an equal chance, she should put the dairyman to shame, and in her modesty, blush in the recognition of his short-comings in her behalf and towards the public.

Supervision of the herd should not be limited solely to diseased conditions, but also to the individual capacity of the animal to produce a standard milk. Therefore, in the feeding of cows, the dairyman, too often, overlooks the demonstrated fact that he should not trust to pasturage alone in asking the cow to produce a standard of excellence, but, to render the latter certain, a grain ration is additionally essential.

It is an exaction beyond reason to expect the gentle cow to accomplish great things out of the fullness of her nature, without providing her with the necessary pabulum for elaboration.

TRANSPORTATION.

Generally speaking, transportation of milk from dairies to cities is defective. The milk should be transported only in cars, especially constructed for the purpose, to permit of speedy and frequent cleansing, and equipped with facilities for refrigeration. Likewise, protection from the sun and weather at way stations with refrigeration during the heated term, should be insisted upon.

The correction of these objectionable features lies largely with the railroad companies, and unless strenuous and persistent efforts are made by shippers and consignees, there is little likelihood of improvement.

Before filling the cans for shipment, it is essential to scald and thoroughly cleanse them, and the milk should be carefully strained, aerated, and cooled to 50° F. or lower, before being taken to railroad platforms.

The dealer should not fail to scald and thoroughly cleanse the empty cans before returning them to the farmer. Neglect in this matter cannot be too strongly condemned. In many instances a disgusting condition of filth and sourness will be found in empty cans examined while in return transit, and it is not surprising that almost incredible numbers of bacteria are thus generated in these cans, and only killed by live steam or boiling. This should be regulated by law.

STORAGE OF MILK.

No milk intended for sale should be stored, cooled or mixed in that portion of a building used for stabling or for storing manure, or in any room used, wholly or in part, for domestic or sleeping purposes.

All rooms used for cooling, storing or mixing milk should be provided with tight walls and floors made from a non-absorbent material, and kept scrupulously clean. They should be equipped with proper appliances for washing and sterilizing all utensils employed in handling.

No urinal, water-closet, or privy should be located in or near such rooms, or so situated as to pollute the atmosphere of these compartments, and it goes without saying that all plumbing should be strictly sanitary.

CITY DELIVERY.

With the best efforts, it is impossible for some dealers, in large cities, to deliver milk to the consumer before it has attained the age of 24 to 36 hours. Except during the winter temperature, this naturally brings many attending evils. The evils of over-aged, non-protected milk suggests the early adoption, during the summer months, of making it mandatory that milk cans should be properly labeled at point of shipment, with date, verified by railroad station agent, and none permitted to be sold in the city over 28 hours old, and then only when protected by refrigeration both in transit and in storage. Railroads are slow, on account of expense, to adopt cold storage protection in transit, and until this can be accomplished it would be well to interdict, during the hot season, all milk brought from too distant points.

Age labels, refrigeration, limitation of haul, are cogent factors in milk protection, and no system is complete without supervision in these lines.

As a means of identifying milk dealers and their actions while delivering it, it is essential that each wagon should properly and conspicuously display upon each side the number of his license, and in the case of peddlers from cans carried by hand, the number should be properly shown on the can. This latter feature of the business should be abandoned, as from its nature, and as experience has shown, they are the most frequent offenders in milk adulteration, and the most difficult to detect.

GLASS JARS AND BOTTLES.

In many towns, a large percentage of milk is served in glass jars and bottles, a plan which we acknowledge possesses in some respects advantages to both dairymen and families so supplied. However, there exists a most serious objection to this method, while convenience and facility of access are its only recommendations, it is altogether out-

weighed by the inevitable and terrible risk of the susceptibility of milk as a medium for the transmission of infection. For milk is a common article of food for invalids and convalescents, therefore, when these bottles are taken into the sick room and there contaminated with the germs of disease, if not boiled or thoroughly sterilized, become the means of spreading the mischief indefinitely. Many obscure cases doubtless have originated in this manner. To properly sterilize bottles involves a serious loss from breakage, and it is almost safe to assume that glass bottles are seldom placed in water of sufficiently high temperature to destroy disease germs.

The temptation also presents itself to milk peddlers to refill bottles on their wagons. The harm done through such acts is incalculable.

An ordinance prohibits bottle delivery of milk to houses placarded for infectious disease, in Buffalo, and a severe penalty is placed upon refilling bottles at any other place than the dairy.

MILK SOLD IN STORES.

Many stores and groceries, for convenience of customers, have milk on sale. The small amount dealt in is subordinate to their business, and considered as a side issue, with absolutely no protection whatever.

This sort of milk traffic should be stopped, because of the possibility of contamination by draughts, store-dust, decomposition, odors, are always present in a large degree, while protection, as stated, is nil.

SKIMMED AND SEPARATED MILK.

The sale of skimmed milk should be permitted as it possesses some food value at low cost, but its existence necessitates scrutiny to insure the public from fraud.

By legal decision, and sanitary requirement, in some cities, the two are differentiated and made standard, the one "skimmed" representing an article from which cream has been removed in part, it retaining six per cent. by volume of cream, and two and one-half per cent. by weight of fat, the other, "separated," being practically a dairy refuse with total fat extraction, a vast distinction.

Protection from substitution is obtained by only permitting its sale from a different and specially colored or shaped can (lettering soon becoming obliterated by use), in order that purchasers may, at a glance, know the character of the contents.

MILK STANDARDS.

In order to secure convictions for selling inferior or impoverished milk, a certain average standard is prescribed.

Being of importance to consumers, as well as producers and dealers, we quote the following suggestion for testing milk, as published by the New York City Department of Health.

By the Cream Gage—Fill the cream gage one-half full with water, at a temperature of 120° Fahrenheit, to which has been added a few drops of a strong solution of washing soda. Then, after stirring up the contents of the can thoroughly, fill the gage to the top mark with the milk. Shake well and place in very cold water (say 40° Fahrenheit). In about thirty minutes the cream will have risen and the percentage can be read off, remembering that the result observed must be multiplied by two, as one-half (½) water and one-half (½) milk was used. Example: Eight per cent. of cream was observed by this test: Multiplying this by two would be 16 per cent., which would be the true amount of cream contained in milk by this test. Good milk should show by this test 14 to 18 per cent. of cream.

By the Lactometer—To test for water, the lactometer can be used as follows: Stir the milk to be tested so that a fair sample can be taken. Warm or cool enough milk to 60° Fahrenheit to fill the testing cylinder. Insert the lactometer in the milk in the testing cylinder, being careful not to wet that part of the stem above the milk, and observe where it floats. Pure milk will not fall below the 100° mark on the lactometer at 60° temperature. It must be remembered that skimming the milk will make the lactometer float higher and the addition of water or cream may make it sink lower than 100, but if the appearance of the milk upon the lactometer is noted, no one can mistake watered milk for milk to which cream has been added, nor pure milk for milk from which the cream has been removed, as in skimmed milk. In other words, if the lactometer floats below 100° and the milk looks thin, water has been added. If it floats above 100° and the milk looks thin, it may be skimmed or skimmed and watered, but if it floats above 100° and looks creamy and yellow and sticks to the glass, you can be reasonably sure that it is pure. Good average milk will indicate about 109° on the lactometer at a temperature of 60° Fahrenheit, and show 14 per cent. of cream by the cream test given above."

The rules adopted by the Philadelphia Board of Health advise all milk dealers with a standard lactometer and thermometer, and test all milk received for sale by them. Instructions in the manner of testing are given by the inspectors. We quote the following from the report of said city:

"The test used by the Philadelphia inspectors of milk in their daily examinations is the lactometer, or specific gravity test. The lactometer is an instrument of the hydrometer class, and is arranged specially to ascertain the specific gravity of milk. It is graduated from 0 to 130,

the former representing the gravity of water, which is 1 or 1.000, and the latter 1.03770 specific gravity. The figures on the stem of the instrument are arbitrary, but their equivalents may be learned by referring to the table.

"Innumerable tests by eminent chemists fix the lowest gravity of normal milk at 1.02900, or 100 on the lactometer stem. Where the result by the lactometer is accepted as final and conclusive this may be satisfactory, but it is not so in this city. Gravimetric analysis only determines conclusively the quality of the milk. At best, all other methods are approximations, and consequently unreliable as evidence.

By way of illustration, suppose a milk shows 1.03190 specific gravity, or 110 on the lactometer, and sufficient water is added to lower the gravity to 1.02900, or 100 lactometer indication. Surely it would not be unadulterated milk although within the prescribed limit of safety.

The experience of daily inspections and analysis proves that the fair average of the milk of a healthy and reasonably fed herd of grade or domestic cows is 1.03190 specific gravity, or 110 lactometer reading.

Low gravity is due to an excess of cream or water. No one familiar with milk it may be presumed could fail to discriminate between these causes. The removal of cream raises the gravity of milk according to the care exercised in skimming and the quantity removed. The range on the lactometer for skimmed milk is from 115 to 130. But normal milk is frequently met with having a gravity between these limits, therefore, when milk with high gravity is examined it should be carefully scrutinized to determine by the viscosity or body whether it is skimmed or otherwise.

Watering or skimming converts milk from viscous to comparatively a thin or almost translucent liquid. For the purpose of concealing the addition of water or the abstraction of cream, coloring matter is sometimes used. A chemical test is necessary to establish the presence and character of coloring matter. An unusual yellow appearance in milk at any other than pasture seasons may safely be ascribed to artificial coloring.

"A simple and convenient method to test milk suspected of skimming, is by the use of the creamometer. This is a glass cylinder graduated by lines from 0 to 30, each line indicating one per centum. The tube is filled to the 0 line with the milk and set away for 24 hours, when the per cent. of cream may be read off by lines, reading downwards. The raising of cream is facilitated by warming the milk to about 80 degrees Fahrenheit, after which it should be rapidly cooled. Another method is to fill the vessel to the 0 line with equal portions of milk and water. In case water is added as suggested, the indicated percentage is to be multiplied by 2. It should be borne in mind, that a "heavy

bodied" milk presents a greater resistance to the cream rising than a light bodied milk, hence it is that watered milk creams more rapidly than the unwatered article. Under the microscope, the fat globules may be seen floating in this emulsion of caseine, milk sugar, salts or mineral matter and watery fluid of whey. These globules vary in size from 1-10,000 to 1-25,000 of an inch in diameter, and are so small that they lack sufficient buoyancy to reach the surface at all.

"Centrifugal force even as exhibited in the separator cannot expel all those minute bodies from the milk, so that from 0.1 to 0.5 per centum of fat may be found in the residue of the separator. Seeing that centrifugal force cannot bring all of the cream to the surface, it is evident that the test suggested is only an approximation. It is sufficiently accurate, however, for the purpose."

ADULTERATIONS.

For the purpose of defining adulterated milk, we have drawn upon several sources, and submit the term as meaning the following:

FIRST. Milk containing less than twelve per cent. of milk solids.

SECOND. Milk containing more than 88 per cent. of water or fluids.

THIRD. Milk containing less than three per cent. of fats.

FOURTH. Milk drawn from cows within fifteen days before or within five days after parturition.

FIFTH. Milk drawn from animals fed on distillery waste, or any substance in a state of fermentation or putrefaction, or on any unhealthy food.

SIXTH. Milk drawn from cows kept in a crowded or unhealthy or unsanitary condition, or from cows affected with any form of disease, or from cows which are supplied with impure or unwholesome water.

SEVENTH. Milk from which any part of the cream has been removed.

EIGHTH. Milk which has been diluted with water or with any other fluid, or to which has been added any foreign substance whatever.

NINTH. Milk drawn from cows or by milkers that are themselves in a condition of filth or uncleanliness.

TENTH. Any milk which is shown by analysis to contain any substance of any character whatsoever not natural or normal constituents of milk, or have been deprived, wholly or part, of any constituent naturally or normally contained in milk.

CONDEMNATION.

All milk found to be adulterated, according to the previous definition, should be condemned by the inspector and immediately destroyed. Any other method of procedure is unsafe and unsatisfactory.

PROSECUTIONS AND PENALTIES.

Prosecutions for violations of milk laws should be vigorous and unremitting, and the penalties should be so heavy as to deter any person from assuming even the remotest risk.

It has been held by a Pennsylvania Court that "Ignorance of the character and quality of the article is no defense. The defendant is bound to know the character of the article which he sells as of a particular quality or kind."

Philadelphia has sentenced offenders, against milk laws, to imprisonment for six months, in addition to a heavy fine.

The laws of Massachusetts, as well as those of several cities, require that the name and place of business of every person convicted of selling adulterated milk, or having the same in his possession with intent to sell, to be published in two newspapers in the county in which the offense is committed.

It is suggested that if the dealer would test the milk before removal from the city depot, and immediately reship it to the farmer, if found below the standard, the producer will soon furnish a better article.

MILK PRESERVATIVES.

Boracic acid, salicylic acid, salicylate of soda and a weak solution of formaldehyde are among the principal ingredients employed for preserving milk. Treating milk in this manner clearly constitutes an adulteration, and should be vigorously prosecuted.

COLORING MILK.

The substance chiefly used for coloring milk and cream, as well as butter, is annatto. Its use is to conceal watering or the abstraction of cream, and giving to milk or cream an appearance which is unreal.

Irrespective of other considerations it is a deception and a fraud upon the consumer.

In his reply to the Boston Health Department, Dr. Davenport gives the result of a microscopic examination of paste annatto, or of the alkaline solution of it as employed for coloring milk.

"The investigation showed the presence of innumerable bacteria, a necessary result of the putrefactive changes through which the coloring matter has passed. It is not surprising, therefore, that milk to which even the smallest quantity of annatto coloring has been added should sour much more rapidly than pure milk, a fact which has long been known to milk men, and many times acknowledge by milk men of whom inquiries were made."

Thompson, in his Chemistry of Organic Bodies, describes annatto as the fruit or coccus of a plant containing small red seed, from which the coloring matter is extracted through a sort of putrid fermentation.

It has no taste but a disagreeable smell resembling that of putrid urine, which smell, he says, is not natural, but is communicated to it by the addition of urine, in order to keep it moist and improve its color.

CONDENSED MILK.

In some places condensed milk is permitted to be sold in other than original packages by labeling the cans. This is a practice which easily admits of substitution for dairy milk. In our opinion, the sale of condensed milk should be permitted in original packages only, the packages being properly labeled with the name and address of the maker. This milk should be subject to the same restrictions and inspections as dairy milk.

PERMITS AND LICENSES.

This report covers, in detail, the "License System" for milk protection.

This system, which includes inspection, scrutiny, detection and punishment, is the best yet devised for the purpose. It further simplifies scrutiny and localization from source to the consumer, deters fraud and detects infection.

In conclusion, the attitude towards the milk industry should be both State and Municipal control, operating in harmony under similar principles with the identical object in view both acting together, forming a system of protection from dairy to consumer.

The State should exercise its functions and control until it passes to within the Municipal limits and authority, and should include every feature and detail in all respects of protective sanitation. These features include briefly:

1. The license system, with fee, periodic systematic inspections with revoking power and penalties for dereliction.

2. The inspection system should include inspection of herds (tuberculin tests), foods, animal care.

3. Demand sanatory environment and buildings, correcting existing evils, and examination and approval of plans, pending erection of new ones, which should comply with a standard of sanatory construction with especial reference to specific requirements of the business—viz., separate milking and stabling quarters, proper cubic air space, non-absorbent material.

4. Scrutiny of water supply, standard feeding, health of employes, hygienic care of utensils and cans, cleanliness and protection in milking.

5. Definite rules governing all procedures, particularly as to the cooling process, preparation for market, and in relation to the varying seasons.

6. The differentiation of the various characters of milk by different colored or shaped cans, and being properly labeled with date of milking, time of shipment.

7. Prohibition of milk preservatives and coloring agents, of adulteration, and of the marketing of milk from diseased, sick or parturient cows, of the use of disinfectants, their necessity implying bad sanitation.

8. The prohibition, particularly, of refuse or swill food upon any dairy premises, of any food, by reason of decomposition or fermentation, considered unhealthful, and of the association of other domesticated or housing animals with cows.

9. A standard of quality, with periodic testing and analysis.

10. Veterinary inspection with distinction and compensation within, and quarantine against the introduction of tuberculous cattle from without the State. It should be as rigid as against pestilence in man, and it is only by this means that the malady can be circumscribed, and its bearing on human life favorably influenced.

With this standard of supervision by the State, the Municipality should continue the supervision upon the same lines, and which may be outlined as follows:

1. Continuation of the license system with penalties, together with stringent ordinances covering quality, adulteration, sanatory care, and relation to contagious disease contamination.

2. Milk should comply with the State standard as determined by lactometer tests, periodically instituted, as ascertained both in milk houses and on wagons.

3. Sanatory non-absorbent milk-rooms, of determined size, air space, ventilation and light. With specifically constructed, indirect plumbed cooling and storage boxes, and non-communicating with sleeping-rooms, privies, stables or other influencing rooms.

4. Wagons properly lettered and numbered, with protection from summer heat.

5. Stringent prohibition regarding intercourse with houses containing contagious diseases, particularly relating to the exchange of milk bottles, and the prohibition of refilling jars en route. The constant surveillance of contagious disease in relation to milk routes by means of the "Tell-tale Register."

6. Obligatory cleansing of milk utensils by a uniform method, and of cans before returning to the dairy.

7. Special supervision of and discouragement, if not abolishment, of grocery store and similar character milk sellers, where the business is subordinate to other interests, and consequent lack of protective facilities.

8. Until State and city act in unison in this, where interests are identical, the adoption of arbitrary interdiction or destruction, at the city line, of all milk coming from dairies whose conditions, or herds, may have a deleterious influence upon the milk.

9. Systematic system of reports, and with mutual warnings and notification of imperiling conditions.

FORMALDEHYDE AS A MILK PRESERVATIVE.

By A. G. YOUNG, M. D.,

Secretary State Board of Health, Augusta, Maine.

A local newspaper discussion of this subject led me to address a circular to the secretary of nearly all the state boards of health, to the department of health of fifty-six of our larger American cities, and to every agricultural experiment station in the country. The letter contained the following questions:

I. What is your opinion or that of your board regarding the use, by dairymen and milk dealers, of formaldehyde as a preservative of milk?

II. Do you believe that, used as a preservative, formaldehyde impairs, or has a tendency to impair, the nutritive value of milk?

III. Do you think that, when thus used in milk, formaldehyde has a tendency to interfere with the digestive processes?

IV. Kindly let me know whether your board is taking any action, or adopting measures to prevent the use of formaldehyde as a preservative of milk, and if so, what action.

The last question was omitted in the letter sent to the experiment stations.

Tabulating the answers to the first question, or the opinions as to whether it is right for dairymen to add formaldehyde, as a preservative to the milk which they sell, from 15 boards a distinct negative was received, from one an inclination to an affirmative, and from seven there was no reply to this first question.

Of the city boards, 24 are opposed to the use of the agent in question as a preservative, three did not answer, and one gave an equivocal answer.

From the experiment stations 30 answers were positively against the use of formaldehyde in milk, none countenanced its use, seven letters did not answer this question.

Of all the officials heard from, state, municipal, and experiment station, only one answer indicated that the writer deems it right or expedient to encourage or to allow dairymen to use formaldehyde in milk. This expression of opinion is of interest and of some value as an indication of the sentiment of public health officers and the experiment stations on this question. Many of the letters contain strong and positive statements of the convictions of the writers that formaldehyde should not be added to milk and why it should not. That these opinions come

from men in the best positions to answer this question understandingly, and that they represent both sides of the question, the economic as well as the public health side of it, should add weight to what they say.

As to the action of formaldehyde on the nutritive value of milk, or its influence on the digestive and assimilative processes, or what effect its prolonged ingestion, even in small quantities, has upon the excretory organs, our knowledge is incomplete, though experimental work and clinical observation have put up a few finger-boards.

Experience of late years in laboratory and anatomical work has abundantly shown that formaldehyde in solution or as a free gas, hardens albuminous matter and converts it into a substance with a leathery appearance. The object of some European experiments has been to determine whether solutions of formaldehyde might not be used for the preservation of meat and fish; but these articles have been injured and rendered unfit to use as food products. Gottstein[1] determined that such food products, hardened by the use of formaldehyde, cannot again be softened by boiling. Though not proving the fact conclusively, we would naturally infer, that used in milk, even in small quantities, the tendency at least of its action on the proteids would be in the same direction.

One of the bulletins[2] of the Cornell University Agricultural Experiment Station says: "The behavior in the Babcock test of milk which had been preserved by formalin shows that its composition is in some way affected. Ordinarily the curd of milk is dissolved by the sulphuric acid that is used in the test. Where formalin is used the curd often fails to dissolve and becomes a compact mass. If this preservative can so alter milk that sulphuric acid may fail to dissolve its curd, is it not at least probable that the action of the gastric juice in the stomach may be rendered less effective?"

The investigations of T. H. Weigel and S. Merkel[3] showed them that the casein of milk which has been treated with formalin should never be added to milk intended for children. They also state distinctly that formalin interferes with the digestion of milk.

Bliss and Novy conclude from an extensive study of this problem that the casein of milk, on contact with formaldehyde, undergoes very rapid alteration and is, as a result, not coagulated by rennet, or but very slowly. Such altered casein, like similar fibrin, is not readily digested by the proteolytic ferments. These experimenters found that fibrin is altered by formaldehyde and is less easily digested by pepsin and by trypsin. They found also that trypsin is altered to such an

[1] Deutsche Med. Woch., XXII, 797. 1896.

[2] Bulletin 118, July, 1897.

[3] Forschungsber, ueber Lebensmittel und ihre Begiehungen zur Hygiene, 1895, 91 to 94.—Quoted by Dr. H. J. Wheeler, Chemist, R. I. Exper. Sta.

extent by contact with formaldehyde that it does not digest fibrin at all, or very slowly.[1]

As bearing on the question of the toxic possibilities of formaldehyde the following observations may be introduced:

In the experience of a large number of experimenters and public health officers the inhalation of formaldehyde in ordinary doses, or in the case of animals in large doses, has appeared to be harmless in its results, or productive of no serious harm. This, however, has not uniformly been the case. Dr. Charles Harrington,[2] speaking of the results produced by formaldehyde gas on two rabbits used in his experiments, says that they were sufficiently certain to demonstrate the falsity of the theory that formaldehyde exerts no deleterious act on higher organisms and to render further experiments on his part in this direction unnecessary. Dr. Brough,[3] referring to the results of his investigations for the municipal board of health of Boston, says: "Dogs and cats which have been left in rooms were found killed."

Mosse and Paoletti stated that: "Intravascular injection profoundly modifies the blood, so that hemoglobin passes out from the corpuscles into the plasma. The blood-vessels contract when in contact with formaldehyde, their walls being altered, and their corpuscular elements escaping into the tissues. These points were ascertained by experiments on the renal circulation." A. H. Pilliet states that: "To cause fatal results it must be given subcutaneously in doses of 0.25 gramme per kilogram of body-weight. The lesions consisted principally of intense congestion, with evidence of cellular irritation and vacuolization, but no necrosis. These conditions were noted generally in the stomach, intestines, kidney, liver, spleen, and suprarenal corpuscles."[4]

Graziani[5] injected daily half a grain of formalin diluted into a rabbit. After eighteen days the animal died having lost 183 grams in weight. There was no albumin in the urine, but on section there were present hyperemia of liver and kidneys, and a little swelling of the epithelium of the uriniferous tubules. Another rabbit after receiving from 10 to 15 drops daily, died in ten days. There was hyperemia of the stomach and liver and small erosions of the former.

As the experiments of Rideal and Faulerton on a small number of adult animals gave no positive results, Dr. Annett[6] arranged a large number of experiments on young kittens. The results were that, the younger the animals the more susceptible they proved to the action of formalin. Compared with the control animals, in Group A which had

[1] Jr. of Experimental Medicine, IV, 47, 1899.
[2] Amer. Jr. Med. Sciences, CXV, 69. 1898.
[3] Formaldehyde Gas as a Disinfectant, p. 14, 1898.
[4] Merck's Archives, Vol. 1, 10.
[5] La Riforma Med.—Centr. für Bak., XXV, 683. 1899.
[6] Lancet, 11, 1899, 1284.

one part of formalin to 50,000 parts of milk, the formalin retarded the nutrition of the animals, as indicated by their rate of increase in weight, to the extent of about 29 per cent.; in Group B, with one in 25,000 of formalin, nearly 40 per cent.; and in Group C, with one in 12,500, about 69 per cent. From his experiments with formaldehyde and boric acid, he is forced to conclude that these chemicals, used as preservatives of milk, are very injurious to the health of the consumer, and particularly so to the health of young infants.

Dr. Charles Bock, resident physician to the Indiana School for Feeble-Minded Youth, reports that, on the farm connected with the school, a man was treating seed potatoes with four per cent. solution of formaldehyde. During this man's temporary absence, one of the inmates, a "low grade imbecile," twenty-six years old, strong and healthy, drank from an ounce to three ounces of the solution. He immediately complained of pain in the stomach and began to vomit. The vomited matter was stained with blood. Large quantities of albumen water were given at once, and he had but little difficulty in swallowing it. Free vomiting was produced with a tenth of a grain of apomorphine given subcutaneously. At the end of two hours the man seemed but little the worse for his rash act, although he was somewhat weak and complained of slight pain in the stomach. The administration of albuminous drinks was continued and he seemed to improve until the sixteenth hour, when his pulse began to flag. It continued to grow weak and rose to 92 in frequency, in spite of repeated large doses of strychnine given subcutaneously, together with one dose of nitroglycerine and several doses of sparteine by the mouth. At the twenty-ninth hour his respiration was 40, he was getting restless, and his heart was failing. Seventeen ounces of normal saline solution were injected under the skin, and two hours later sixteen ounces were thrown into a vein, but he presently died. During the last hour of his life there was occasional slight cyanosis.

At the post-mortem examination the upper and middle thirds of the œsophagus showed slight signs of inflammation. The stomach contained four ounces of dark fluid free from formalin. Its walls were in some places more than an inch and a half thick and very œdematous. The cardiac end was very red and highly inflamed. The remainder of the organ was necrotic, dark, and tough and cut like old leather. In the duodenum there was an inflamed area confined chiefly to the valvulæ conniventes.[1]

As bearing on the other side of the question, the experience of Dr. J. N. Hurty, Secretary of the State Board of Health of Indiana, may be cited. He says: "I have found that 5 to 10 drops of the 40 per cent.

[1] New York Medical Jr., LXX, 309. 1899.

solution of formaldehyde will preserve a gallon of milk quite satisfactorily and I do not believe that such an amount of the agent can in any way detract from nutritive value. Neither do I believe it will disturb the digestion. I have conducted some physiological experiments which seem to abundantly support the belief expressed. For instance, I have myself for five months daily taken as lunch, a bowl of bread and milk and have placed in said food 10 drops of 40 per cent. formaldehyde. I cannot by the closest scrutiny discover any ill effect, but on the contrary am inclined to believe that the milk agrees with me better because of the chemical. I have also prescribed a drop of formaldehyde in each bottle of milk in the case of some infants suffering from intestinal disorders and my observations were to the effect that good resulted."

He also states, through the columns of a pharmaceutical journal,[1] that he took the formaldehyde in milk as a preventive of the fermentation which caused acid indigestion. Thus far there is no adverse criticism from the hygienic point of view. That is the therapeutic side of the question. But when from such experiments the conclusion is drawn that it would be a good thing to allow the dairymen to use it—that is an entirely different matter.

Aside from the findings of experimental work and clinical observation there are other considerations which should have due weight when the question comes up whether one shall encourage the general use of formaldehyde or any other chemical preservative in milk.

I. It is a question of encouraging and abetting the addition of potent chemical to a food supply of persons, not all of whom are intelligent and conscientious. If allowed to use it at all, unskilled persons will often add it in unreasonable quantities, granting that any quantity is reasonable and legitimate; and sometimes after the dairyman has added it, the middleman, with milk left on his hands, will pour in more of the preservative to keep it for the next day's sale. At one time some of the foreign adulterators added as much as one gram per litre of salicylic acid, but after restrictive legislation was introduced, they would be content if they might use one-twentieth of that quantity. In a paper read this year by Dr. Alfred Hill, Medical Officer of Health, Birmingham, England, he says that in 5 per cent. of 1,360 samples of milk examined by him, boric acid was found in quantities varying from 130 grains per gallon to 3 grains or less. When the former case came before the magistrates the defendant admitted that he had added a *solid* preservative to the milk.[2]

1 American Druggist.—Sanitarian, XXXIX, 318. 1897.

2 Public Health, XI, 529. 1899.

These incidents are illustrative of the statement of Professor Soule of the Experiment Station of Tennessee, that, "In the greatest number of cases these chemicals would be used by inexperienced and unscientific people who do not appreciate the importance of using just the right amount, hence the use of these preservatives indiscriminately is very dangerous."

II. In the absence of legal prohibition, preservatives enable slovenly and dishonest persons to put upon the market dirty milk, and milk in which the fermentative changes have gone so far before the antiseptic is added that they are unfit as food and dangerous, especially to infants. Preservatives should not be an alternative for cleanliness. Professor Hills, Director of the Vermont Experiment Station, says: "Certain it is that the use of any material of this kind tends to discourage rather than to encourage the making of milk under sanitary conditions. I strenuously oppose any method for the preservation of milk which will tend to make dirty milk more readily kept."

Dr. Frear, Vice-Director and Chemist to the Experiment Station of Pennsylvania, put the matter as follows: "Men coming to feel that they may rely upon chemical antiseptics grow neglectful of conditions of cleanliness which are essential to the production of a healthful article of food. On this second ground of policy, therefore, I object to the general use of any antiseptic."

III. There is no real need of using chemical preservatives in milk. Under unfavorable or ordinary dairy methods, milk contains from a few to many million bacteria to the cubic centimeter and the quantity of dirt is correspondingly great, but with the more careful and cleanly conditions under which some dairymen now have their milking done and the milk handled, the number of germs is reduced to a few hundred and without chemical preservatives or pasteurization, its keeping quality is considerably superior to that of ordinary milk.

IV. When one man, or a few of them, take antisepticized milk for a while and come to the conclusion that the continuous milk supply of the multitude, invalids, babies, and all, may safely be doctored with formaldehyde, their conclusions should be swallowed with a pinch of chlorid of sodium. Von Pettenkofer and others proved that not every person who swallows cholera spirilla develops a malignant or a typical attack of cholera. They proved nothing else. We should remember that we have to reckon with idiosyncrasies and with personal dispositions and immunities in toxicologic as well as in epidemiologic matters.

V. In the earlier years of their use boric acid and salicylic acid were deemed innocuous. Now it is known that, when continuously administered, the by-effects are often undesirable and dangerous. Even boric acid, less dangerous than salicylic acid, is far from being entirely

safe when freely used in surgical practice or as a food adulterant. Professor Dixon Mann, of England, reports as follows: "I have seen several cases in which a purpuric eruption, with nausea, loss of appetite, and depression, followed the dressing of open wounds with boric ointment. * * * I can remember two cases in which thrush in infants was treated with honey and borax, and the application continued long after the aphthæ had disappeared. Nutrition was so much impaired as to cause great emaciation, with intestinal irritation and diarrhœa. * * * I am strongly of opinion that the most stringent restrictions are needed in respect of milk, as being the food of infants and young children, whose nutrition would be seriously impaired by the prolonged ingestion of boric acid, or its compounds, even in small amount." Professor Leach, of Manchester, has expressed the following opinion: "It appears to me that many patients can take either boric acid or borax for a long time in very large doses with impunity, but that, in some people, the unpleasant results are produced by comparatively small quantities, and it is quite possible that serious harm might in these cases follow its ingestion in the quantities in which it is used in the preservation of food. There can be no doubt that it should not be used in the preservation of milk."[1] Concerning formaldehyde it is probable that the opinion of persons who now look upon the prolonged use of small doses of formaldehyde as entirely innocuous may pass through a transitional stage similar to that which professional opinion has lately experienced in regard to the use of the older preservatives.

VI. One of my correspondents, though not advocating the use of formaldehyde as a milk preservative, is under the impression that it speedily evaporates after it is added to it. Those, however, who have had much experience with formaldehyde in the disinfection of clothing or in subjecting various kinds of organic matter to its action would be inclined to believe that this correspondent is mistaken. Formaldehyde appears to enter into some kind of combination with fabrics and with many other kinds of organic matter so that it is not easily dissipated. The recommendation has been made to heat milk to which formaldehyde has been added to drive off the chemical; but pasteurization or sterilization in the first place would be the preferable alternative, if heat is to be applied at all. In connection with infant feeding we hear something of the devitalizing influence of heat on the milk, but it is questionable whether the influence of formaldehyde in this direction is not the greater of the two evils, irrespective of the influence of formaldehyde on the digestive and other vital processes. Professor S. M. Babcock, Chief Chemist of the Experiment Station of the University

[1] Public Health, XI, 529. 1899.

of Wisconsin, writes: "Formaldehyde not only renders the proteids of milk less digestible but, when added in sufficient quantities to suppress bacterial growth, destroys the proteolytic enzymes contained in the milk."

L. M. Tolman, Chemist to the Board of Health of Oakland, California, says: "The action of formalin in milk increases the total solids, probably in two ways, by hydrolysis of the sugar, and by formation of polyimerids of formaldehyde which are non-volatile, therefore the argument that formalin is a good preservative and suitable to preserve foods because it can be driven from the foods by warming or other means, may not be true."

VII. One correspondent suggested that the use of formaldehyde might, perhaps, be allowed under a law establishing a legal maximum. That, it seems to me, would be very nearly equivalent to a complete surrender to the adulterators. It would, further, entail upon the State a costly inspection service which but few of our commonwealths would support. In this connection the words of Dr. H. W. Hill, Director of the laboratory of the Department of Health of Boston, are of interest: "Until the exact amount which may be preservative without being in any way harmful is determined (if any such amount there be) official commendation should, I think, be withheld. Moreover, the authorities are agreed that the qualitative tests are so delicate as to allow the recognition of one part of formalin in 500,000. But they are also agreed that *quantitative* tests are unreliable. It would seem then that it is at present unwise to sanction the addition by untrained or irresponsible parties of formalin, even in small amounts, when the actual amount added cannot be determined by analytical tests. Such sanction permits the addition of a possibly dangerous substance while taking out of the hands of the authorities the power to determine in any given case how much has been added."

Conclusions. The results of my examination of all the available printed and other reports regarding the action of formaldehyde seem to me to justify and require the following conclusions: That used as a preservative it *tends* at least to impair the nutritive value of milk; that its tendency is also to interfere with the digestive processes—in either case it is only a question of dosage, and the limit of safety is difficult to determine; that, though the inhalation of formaldehyde gas is much less dangerous than the breathing of the other gaseous agents much used as disinfectants, the results of tests upon animals and one case of accidental poisoning of a human being, indicate that formaldehyde, taken into the digestive system may produce dangerous and even fatal results; that it would be unwise and unsafe to encourage or to suffer the use of formaldehyde in the public milk supply, even under any possi-

ble restrictive regulations; that in every state, as there are now in many, there should be a law prohibiting with effective penalties the use in milk of any chemical preservative whatsoever.

These, at present, are the only rational and safe conclusions. If new light arises in the future we can take our bearings anew, and correct our course if need be.

FOOD ADULTERATION IN ITS RELATIONS TO THE PUBLIC HEALTH.

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Mr. President, Ladies and Gentlemen—The conservation of the public health is a duty which is not peculiar alone to the medical profession. While the world looks to those of us, who have received medical training and have taken medical degrees, for instruction in hygiene and the rules which should regulate life, the popular idea of the physician is rather one to whom appeal is made when the health is broken and disease has seized upon the vital organs. Nevertheless, in spite of this popular impression of the functions of a physician, the world is turning more and more to the physician for information on all subjects which pertain to health and longevity.

The desire to live to "a green old age" should also be accompanied by the effort to make this life as free from disease and suffering as possible. A prolongation of life which means simply the prolongation of an invalid's life is not one to be greatly desired. The economics of valetudinarianism are matters of some moment because the invalid is a burden, either to himself, to his friends or to society at large. The ideal of life, the one which results in work accomplished and in progress achieved, is, other things being equal, a healthy life. I make this statement with a full knowledge that many great works have been accomplished by invalids. Sometimes it may even be said that sickness is the prime cause of great achievements, since it isolates the invalid from contact with the world, and enables him to concentrate his powers upon a single object. But sickness is not necessary to secure concentration of thought and purpose, these can be far better accomplished by the forces of will and the law of habit.

The physician need not be deterred from teaching the laws of health because he fears that he may diminish his professional activity. It requires a certain amount of sickness to kill an invalid and if this be extended over a period of eighty years the physician will make as much out of it as he could have accomplished in forty, so that from a mere business point of view there is no reason why the physician should not be the teacher of hygiene.

Among the many factors which have a great influence upon the health of the individual there is none more potent than food. Eating is the chief industry of the human race. In this country there are about thirty million wage earners, drawing about twenty-five million dollars a day. Of this vast sum fully three-fourths are applied to the

purchase of food and its preparation. It seems to me therefore that a subject which monopolizes three-fourths of the energies of the human race is one which is well worthy of discussion, and especially among a body of physicians, who have banded themselves together not particularly for the curing of disease, but for the more beneficent purpose of conserving the public health.

Often even wholesome foods may be administered in such a way or in such excessive quantities as to injure the health of the consumer. If this be true, how much greater must the danger be if the food offered for consumption be changed in its nature, so as to become a positive poison, by the addition of foreign bodies? Perhaps there is no one evil now prevalent in this country, not even the intemperate use of alcoholic drinks, which has more vital importance to the health of the people than the adulteration of our foods.

In the short time allowed to this paper I cannot enter into an elaborate discussion of the nature and extent of food adulteration, but must confine myself closely to the question under discussion, the influence of this adulteration on the public health.

Not long ago I stated, before the Senate Committee investigating the adulteration of foods, that all adulterations of human food might be comprised in three classes. The first I described as adulteration with bodies which are innocuous or harmless; the second, the addition of positively injurious bodies; and the third as the abstraction of some valuable constituent from the food, and either leaving the food without this constituent altogether, or replacing it by one less valuable.

A distinguished gentleman, who followed me on the witness stand, took exception to the classification I had made, saying that in his opinion there was no kind of adulteration which was not injurious to health and that therefore the first class mentioned by me was just as objectionable as the other two. During the last few months I have thought a great deal on this point and have almost come to the conclusion that my friend was right in his view. I will illustrate the classification, however, by pointing out a few well-known adulterations of each of the three classes I have just mentioned.

It is well-known that flour made from wheat has been largely adulterated in this country by the addition of purely starchy matter derived from Indian corn. Now I cannot regard starch as injurious to health, and hence the addition of a starchy body to the flour of wheat is in this sense not an injury. Physiological chemists, however, have discovered that there is a certain balance in the foods of man which should not be disturbed. In other words, there is a definite relation between the quantities of protein, fat and carbohydrate matters, which, when sustained, renders this mixed food most nutritious, and therefore most economical. Bread made from wheat flour,

especially if it be made as nearly as possible from the whole grain, is recognized by physicians and physiologists as being practically a complete human food, with a certain definite ratio existing between the protein matter which it contains and the fats and carbohydrates. It is evident at once that the addition of other starchy matter will disturb this ratio and thus render the food less economical, by increasing enormously one of its constituents without changing the quantities of the others. For the ordinary healthy stomach such a change in the food would be of no consequence whatever, but we can readily imagine cases where, with the disturbed digestion and imperfect secretion of the enzymes which produce fermentations characteristic of the digestive process, the increase in the amount of starch would produce a positive injury. We know that starch is digested first in the mouth by the action of enzymes of a diastatic nature, secreted by the salivary glands. The slight alkalinity of the digestive fluid favors the action of the salivary enzymes. When the food reaches the stomach, in natural digestion, it becomes acid under the action of the hydrochloric acid secreted by the glands of the stomach. The enzymes of the peptic ferments are also secreted in large quantities and act rapidly upon the protein matter of the food, converting it into peptone. This action is favored by a slight acidity. It is evident, therefore, if the digestion of the starch does not proceed under the most favorable conditions in the stomach, any excess of starchy food may interfere seriously with proteolysis. In other words, the amylolytic ferments and the proteolytic ferments do not reach their maximum activity in the same environment. The mixing of Indian corn starch, therefore, with wheat flour, while it is an adulteration of the first class, being the addition of a harmless or innocuous substance, may in the cases mentioned above, become a positive injury to health.

Another illustration which may be cited is in the case of the glucose of commerce. Now, the glucose of commerce is a mixture of dextrose and dextrine with a small quantity of maltose, produced by the artificial hydrolysis of the starch under the influence of an acid. It is well-known that the starch in foods must undergo a similar hydrolysis, under the action of the diastatic ferments, of the digestive organisms, before it can be assimilated and act as a nutrient for the body. From this fact it might be inferred that a partial previous digestion of the starch, by an artificial hydrolysis, such as is referred to above, might be of advantage. This, however, cannot be seriously admitted. It is a well established principle in physiology that the disuse of organs tends to produce atrophy and eventually functional paralysis. Hence, if the starchy foods are replaced by artificially digested starch, the organs which produce the diastatic ferments to hydrolyze the starch, are deprived of a part of their functions and

must suffer from disuse. It is evident, therefore, from this point of view, that the use of predigested starch is to a certain extent prejudicial to the health of the digestive organs. Where the digestive ferments are deranged and the digestion of starch rendered difficult, the addition of predigested foods may be useful, but these should not be substituted for the natural foods, except on the recommendation of a competent physician. Again, there may be objections to the use of glucose from another point of view. This substance is, as is well-known, largely used as an adulterant for honey and jelly. Honey owes its value to the peculiar flavor which it possesses, due to the aromatic substances derived from the flowers and possibly to traces of formic acid, obtained from the digestive organs of the bee. In other words, honey is not prized simply because it is a carbohydrate, but because of its flavor. Whenever, therefore, glucose is added to honey, by the substitution of it for the aromatic substances, above mentioned, the peculiar flavor is destroyed and the honey is to that extent less desirable. So here is another instance in which the introduction of a perfectly harmless substance in food may render it positively injurious.

I will not multiply illustrations of this kind, but in general it may be predicted of all such adulterations, with harmless or innocuous substances, that they may be comprised within my first class.

When we come to the second class of adulterations there is less ground for dispute. Here I think no physician will fail to condemn the use of bodies in foods which are positively injurious. The excuse usually urged for the use of these bodies is that they are in such minute quantities that they cannot possibly be injurious. This I readily grant is valid for healthy stomachs, of individuals who are in the prime of life and who are in the full possession of all their powers; but it can hardly be general in its application.

Adulterants of this class are best illustrated in the use of preservatives. For economical reasons foods are not always consumed on the spot where they are produced nor at the time of their production. Many foods are of a perishable nature and if not consumed at the time of their maturity are lost. To render these foods servicable through the entire year, and in localities widely separted from the place of their origin, some method of conservation must be employed.

There are two methods of food preservation which are perfectly natural and permissible. One consists in the complete desiccation of the food so as to prevent the fermentation which produces decay. The second method is to subject the food to a pasteurizing or sterilizing temperature for a time sufficiently long to destroy the germs of fermentation. The foods thus pasteurized or sterilized are prevented from coming into contact with the air, and thus by excluding the fer-

mentative germs they can be preserved indefinitely. Both of these processes are to a certain extent troublesome and expensive and hence dealers in foods have sought to accomplish the same result by a shorter and easier course, namely, the employment of certain chemicals which have the property of retarding, paralyzing or destroying the activity of the fermentative germs. All food preservatives act essentially in the same way.

It is well-known that there are a great many substances which possess neither taste nor odor and which have this retarding action upon the fermentative germs. The addition of these bodies to foods secures their preservation and at the same time does not impair their flavor. Among the preservatives which have been commonly employed in this way may be mentioned sodium sulfite, boracic acid, borax, potassium nitrate, sodium chlorid, sodium silico-flourid, potassium flourid, sulfurous acid, formaldehyde, salicylic acid, benzoic acid. abrastol and saccharin. A glance at these substances will show that they are of two general kinds, those of an inorganic nature which are mentioned first, beginning with sodium sulfite and those of an organic nature, beginning with formaldehyde. I have omitted all preservatives which on account of odor or taste could not be conveniently used in the preservation of human foods.

It will be noticed that some of the bodies in the first class are of a condimentary nature and therefore cannot be rigidly considered as food preservatives. We must not exclude from foods the condiments with which we are familiar. They are necessary and desirable, although being of themselves of little food value, and hence the use of any one of the bodies mentioned above, in a condimentary sense, cannot be considered reprehensible. Of the bodies mentioned above, those which are most commonly used as condiments are common salt and potassium nitrate, the latter, however, to a very limited extent.

In the second class the only one which is used in the condimentary sense is saccharin and that only as a rule in the case of persons suffering from diabetes, where the use of a carbohydrate in the food is deemed inadvisable, and where the patient craves a sweet taste in his food. In the case of this condiment I cannot speak favorably since under any circumstances I consider its use highly injudicious and injurious.

In general it may be said that all decay of foods is due to germ action. I can easily remember the time when it was supposed that the decay of organic matter was due to oxidation by the air, but since the time of Pasteur this idea is no longer entertained. The sole function of the addition of preservatives, therefore, is to paralyze or suspend the germ action and thus preserve the foods from decay. On the other hand, we should not forget that the process of digestion is

essentially a fermentation from beginning to end. The splitting up of the organic food elements into simpler forms, which can be assimilated and utilized in the system, is due solely to the action of ferments, belonging to the general class of enzymes.

The decay of foods is due to fermentative action, caused by organisms, capable of reproducing their kind, and to the enzymes which are secreted by the living organ. The process of digestion in the alimentary canal is due almost solely to the latter cause, the action of the germs capable of self reproduction being extremely limited, and even doubtful. It may be stated, however, that any substance which has the property of suspending or retarding the action of germs capable of reproduction has a similar action upon the enzymic ferments. Therefore it follows that when these substances, which are added to preserve foods, reach the alimentary canal their paralyzing action will continue during the process of digestion. Hence this broad principle should be enunciated, as being definitely established, that all substances which are capable of preserving foods have also the property, to a certain extent, of retarding the processes of digestion.

The question therefore arises should the use of preservatives in foods be absolutely prohibited. I for one do not believe in prohibition of any kind. To my mind every human being should be left absolutely free to choose for himself what he should eat and what he should drink. If, therefore, my neighbor is fond of food preservatives, I, for one, have no desire to prohibit his indulgence therein. My duty and it seems to me, and that of every other teacher of hygiene, is to protect the innocent party who has no desire to eat adulterated foods. So far as I am concerned, therefore, and so far as the public health is concerned, it would be sufficient to permit the use of the least harmful preservatives, on the condition that the kind and amount of the preservative employed be marked in plain letters on every package containing it. When it comes to positively injurious preservatives, however, which even in minute quantities are injurious to health, then I too almost become a prohibitionist and would favor the restriction by national or state laws of the use of such substances in human foods.

It is claimed, for instance, by many competent hygienists and physiologists that a moderate use of borax or boracic acid in butter is of a condimentary as well as of a preservative nature and does not in any way tend to interfere with the process of digestion. Claims made in this manner are worthy of consideration. It seems to me, therefore, that it is eminently proper that this body of physicians assembled in the interests of the public health, should petition the Congress of the United States to enact one of the many pure food measures which have been brought to its attention, into a national statute, and provide at the same time for the appointment of a commission composed

of physicians, physiologists and chemists, to study the nature of all proposed food preservatives and to determine which, if any, should be permissible in human foods.

There is one other form of food adulteration to which the attention of this body should be called and that is the artificial coloring of foods. Artificial colors are now used to a large extent in human foods, chiefly in butter and oleomargarine, canned meats and preserved vegetables. Butter and oleomargarine were formerly colored yellow with turmeric. The introduction of the coal tar dyes provided a cheaper coloring matter and one of the azo-dyes, tropæolin, which gives a bright yellow color and at a smaller expense has almost entirely replaced the vegetable coloring matter first mentioned. As a result of this use, turmeric has practically disappeared from the dairy and the synthetic yellow has taken its place. I would regard the use of coal tar compounds as practically in the same category with the organic preservatives above mentioned. While I would not go so far as to prohibit the use of coloring matters in dairy products, I am sorry to say that their use is carried to such an extent as to excite apprehension. In many of our first-class hotels and restaurants the butter is colored a deep saffron tint, totally unlike the delicate light yellow tint which the best natural dairy butter possesses. To my mind the dairyman would do far better to regulate the food of his cows so that his butter would not require artificial coloring matter. In summer this can be easily accomplished by paying careful attention to the grazing of the animals, and in winter can be secured by feeding them root crops, especially beets and carrots in sufficient proportions to give the proper color to the cream and at the same time to increase the flow of milk and preserve the health of the animals. In so far as oleomargarine is concerned, it appears to be entitled to no color at all, but if color is desired it must be secured by some of the methods mentioned.

For the coloring of sausages and preserved meats the coal tar products are chiefly employed. The following is a list of some of the colors which have been used: Bismarck brown, buffalo brown, double scarlet, rouge I, and a red coloring mixture composed of common salt, sodium nitrate, borax and carmin.

The addition of nitrate of soda and nitrate of potash to sausages and meats tends to preserve and at the same time to intensify the red color of the meat. I believe that potassium nitrate is uniformly employed by all packers of corned beef so that it may be considered as a normal constituent thereof.

The green color of peas and beans and other green vegetables, which are preserved by sterilization, is fixed by the use of zinc and copper salts. These bodies act as a mordant, entering the tissues of

the green plants and fixing the chlorophyll, by preventing its transformation into xanthophyll, which would otherwise occur on long keeping. Green peas which are pasteurized without the addition of zinc or copper become yellow by the production of xanthophyll, while if zinc or copper salts be employed the green color is preserved indefinitely. It is well-known that zinc and copper salts are not particularly wholesome, hence their use in preserved vegetables is to that extent reprehensible. How far we should sacrifice our esthetic ideas, as to what food should look like, to purity must be determined by each one for himself. It appears to me that it would be a sufficient protection to the public to require that every package of preserved vegetables, containing copper and zinc salts, should have that fact plainly marked upon the label.

Examples of food adulteration which arise from the extraction of some valuable ingredient from the food and the substitution of a less valuable ingredient are also very numerous. The removal of cream from milk, before it is sold, is a very good illustration of this kind of adulteration. Happily, in most of our large cities at the present day, the milk inspection is so rigid as to practically prevent such adulteration. The laws of most of our large cities require that the milk offered for sale shall contain not less than a certain quantity of fat. The minimum limit is usually three or three and one-half per cent. The content of fat in the milk from a Jersey herd of cows often reaches five per cent. It is thus seen that the thrifty dealer can remove two-fifths of what the natural milk contains and yet sell his article in conformity with the statute. Nevertheless, the removal of this amount of fat is in every sense of the word an adulteration and should receive the same punishment as if it were extended until the limit fixed for the fat had been transgressed.

The use of skimmed milk in cheese making with the addition of lard and cotton seed oil is another illustration. Such a product is known in the trade as "filled cheese." Another common substitution is that of cotton seed oil for olive oil which has been practiced to an enormous extent in this country. This to my mind is a clear case of an adulteration which is not injurious to health. I consider cotton seed oil perfectly wholesome, as much so as olive oil. The fraud in this instance is purely a monetary one, but the offense is just as great and the punishment should be as severe.

From this brief summary of some of the methods of food adulterations it is clearly seen that the practice of frauds of this kind is usually more to be regarded from a monetary point of view than as prejudicial to the public health. Traffic in adulterated foods between the states and territories should be regulated by an act of Congress, while the

legal regulations for the commerce in and sale of these foods should be left to the boards of health of the various states. If national legislation could be brought to act in harmony with state legislation, on this subject, a complete control of traffic in these foods could be instituted, which would be an ample protection of the public, both as far as its pocketbooks and health are concerned.

I will close with one word of warning. When a public audience hears a discussion on the subject of food adulteration it is likely to form wrong notions in regard to the extent of this evil. Exaggerated impressions are formed and expression is often given to them. One would think from some of the articles which have appeared in the newspapers that it would be quite impossible to secure a pure food in any of the markets of the United States. Nothing could be more erroneous than this idea. Most of the foods which are offered on our markets are perfectly pure and wholesome. If one should go into one of our great cities to-day and purchase one hundred articles of food at random perhaps less than five per cent. of them would be found to be adulterated; but because the percentage of food adulteration is small there is no reason to minimize its evils.

The sole objects of food adulteration are to sell an inferior article at the price of a superior one and to preserve a good article, so that it can be sold after preservation at the same price or at a higher price than it would bring in its natural fresh state, and to secure this object reprehensible methods are employed.

I would not say or do anything that would make the price of the food higher for the working man or the poorer classes of this country. I am a thorough believer in the production of oleomargarine and the sale of it as such to those who desire to pay a less price than pure butter commands, and in like manner anyone who prefers glucose to honey, simply because it is cheaper, should be allowed to gratify his taste. My plea is that foods should be sold everywhere for what they are, while the greatest liberty is granted in their manufacture and preservation compatible with the public health. Only where actual injury is done should prohibition be practiced, but up to this point a plain marking of the food containing preservatives or adulterants of any kind, under the proper operation of the state and national laws, would be entirely effective.

THE TRANSMISSION OF TYPHOID BY SEWAGE POLLUTED OYSTERS.

By KENNETH ALLEN, C. E., Baltimore, Md.

THE TYPHOID BACTERIUM.

The science of bacteriology, concerning which so much has been learned in the past twenty years, is yet in its infancy; and in particular, the precise relation in which the pathogenic bacteria lie with respect to the causation of disease remains in doubt. It is very generally believed, for instance, that the *bacillus typhosus* is a distinct species which will, under favorable conditions, produce typhoid in man, and, by reproduction, serve as a medium for the transference of the disease to others; and it is, moreover, believed by many that typhoid is exclusively a water-borne disease. All of these assumptions are, however, contested if not shown to be false; we at least cannot assert their truth.[1]

We find those who feel convinced that the typhoid bacillus is but a special form of, or identical with, the colon bacillus which, as we know, is always present in man's intestinal canal. And we find those who believe that while it is always found in the discharges of the typhoid patient, it is there as a result, not a cause, of the disease. Dr. Louis Parkes, an eminent English sanitarian, has the following to say in this connection in an article in the Journal of the Sanitary Institute of Great Britain of April, 1895: "Bacterial science * * * does not at present permit of any dogmatic assertion that the microbes found in sewage are pathogenic organisms, capable of producing disease in man. According to Dr. Klein, 'The *bacillus typhosus* is now admitted to be almost constantly present in the alimentary canal, in the mesenteric glands, and in the spleen of cases of typhoid fever, and is passed in large numbers from the body of the patient with the fæces. The organism is therefore constantly associated with the disease, but this constant association does not logically prove that the microbe is an indispensable antecedent (cause) of the disease, or even an antecedent (one of several causes in conjunction) of the disease, or, indeed, that it is anything more than a *consequence* of the disease. The chain of experimental proof necessary to completely establish the causal relationship of the organism so constantly associated with the disease is, indeed, wanting.' The absence of the *bacillus typhosus* from sewer air does not, therefore, prove that sewer air does not disseminate the

[1] See Appendix, p. 165.

disease, and it would 'be wiser,' according to Dr. Parkes, 'to assign to the evidence, carefully and toilfully collected by numerous epidemiological workers, at least an equal value to the half-revealed truths experimentally arrived at in the bacteriologists' laboratory.'" Moreover, there are those who believe that its known rarity in drinking water combined with the prevalence of typhoid where the atmosphere is foul, indicate that its chief medium of transfer is the air and not water. In fact, we have the statement of as high an authority as H. Alfred Rœchling, Assoc. Mem. Inst. C. E., that "lately some outbreaks of typhoid fever have been investigated in Germany, where the only explanation was the distribution of the typhoid bacillus through the air."[1] That a vitiated atmosphere predisposes one to typhoid is, at least, believed to be an undisputed fact.

It would be presumptous to assert or deny the correctness of one school or the other, and it is therefore assumed as safest for the present discussion that the popular belief in these matters is in general correct, viz: (1) That the *b. typhosus* is an individual species and not a differentiated form of the *b. coli;* (2) that it is the essential cause of typhoid fever in man, and (3) that typhoid is, as a rule, a water-borne disease. But it must be borne in mind that each of these assumptions is controverted by persons whose opinions are entitled to weight.

THE OYSTER.

The fact that oysters which have been exposed to sewage containing the specific bacteria of typhoid and cholera may be the means of transmitting these diseases has caused much uneasiness in certain localities both here and abroad; and it is well that those placed in control of sewerage works in our seacoast towns should satisfy themselves as to the danger which may result from the discharge of sewage upon or in the vicinity of oyster beds.

The oyster is found on almost the entire extent of our coast line. Of the three important varieties the *Ostrea Virginiana* alone occurs on the Atlantic and Gulf coasts from Cape Cod to Texas; the *Ostrea Lurida* is a small variety found along the Pacific coast, while the *Ostrea Iridescens* is a large oyster inhabiting the Gulf of California.

The importance of our oyster fisheries corresponds to the extent of the oysters' habitat, as is shown by its ranking first among the various classes of this industry. According to recent returns, the value of the output is estimated at $16,152,257, while that from all foreign countries combined was estimated at but $12,698,846. The 9,945,058 bushels from Maryland alone were equal to nearly one-fourth the product of the world.

[1] See Engineering, November 13, 1896.

We see, therefore, that in its commercial aspect the oyster trade is one of great importance, and that it should be sedulously protected from injury. Moreover, it is at once evident that, if susceptible of becoming a vehicle for the transmission of the typhoid germ, its very general distribution along the coast in bays, estuaries and the mouths of rivers, where it particularly appears to thrive, leaves it especially liable to infection.

Now, oysters may be taken for the market either from their natural beds, from artificial layings to which they have been transplanted to fatten, or from storage pits or ponds from which they may be taken as required. On our Atlantic coast north of Chesapeake Bay a large proportion of the oysters are "plants" from artificial layings, but those from the Chesapeake are nearly all from their natural beds. The use of storage pits appears to be more common abroad than here. In Europe less than 8 per cent. are said to come from natural beds, the rest being cultivated from the young or "spat" in parks, or laid in reserves to fatten.

THE SUSCEPTIBILITY OF THE OYSTER TO TYPHOID INFECTION.

As may be inferred, oysters from these artificial layings are in greater danger of infection being, usually, within convenient reach of transportation facilities and hence near centres of population.

In order to draw practical conclusions in the matter it is first necessary to determine whether oysters placed in water containing the typhoid germ may retain it in a state of vitality so as to induce typhoid when eaten raw, and second, the probability of such transmission.

The first question which suggests itself is as to the viability of the typhoid germ in sewage. Dr. Samuel Rideal, in a paper published in the Journal of the Sanitary Institute of Great Britain, says in this connection: "By this time it is well known that fortunately pathogenic bacteria as a rule do not thrive much below blood heat, and that they are rapidly crowded out and destroyed by the ordinary bacteria existing in common waters, and still more by the immense numbers present in sewage. I need hardly refer to the fact that the typhoid bacillus has only in rare case been found even in waters and sewages to which it must obviously have penetrated. This disappearance is clearly explained by some experiments of Dr. Sims Woodhead at Exeter, when he found that crude sewages containing about one-half a million organisms per cu. centimetre, when inoculated into the filtered effluent of a septic tank developed more than 1000 millions in five days, thus overwhelming any pathogenic bacteria that might be present. In the same Local Government Board inquiry Dr. Pickard specially investigated the typhoid microbe, with reference to the action of crude sewage on it, and to the effect of a filter bed on those germs which had

survived a short exposure. He concluded that the sewage itself, even when sterilized, 'was not only a bad food, but an actual poison' to these bacteria, that in the septic tank they suffered a rapid destruction, and that the filter beds effect a further biological elimination 'so that there is no chance whatever of the filtered effluent causing typhoid fever if passed into the river.' "[1]

Experiments have been made by Messrs. Lawes and Andrews in England, which seem to show that the typhoid bacterium will probably die out within fourteen days in sterilized sewage, but that in sea water it may live for several months.[2] They say, "On careful investigation it has been found that the bacillus of typhoid fever is not only incapable of any growth and multiplication in sewage, but that after the first twenty-four hours it slowly and surely dies out, its ultimate death under natural conditions being a matter of a few days, or at most one or two weeks."[3]

Dr. Klein observed that "even as late as three weeks from the commencement of experiment the microbe recovered from the sea-water differed in no way from the typhoid bacillus that has been originally added thereto."

Messrs. Boyce and Herdmann conclude that "The *bacterium typhosus* does not flourish in clean salt water. There is no initial or subsequent multiplication; on the contrary, it seems to die off very rapidly as time increases after inoculation."

Dr. Charles J. Foote, of Yale University, finds, on the other hand, that it will survive for six months in a concentrated solution of salt.

Dr. G. Reid states that "It now appears to be fairly well established that, although organisms survive for long periods in the soil, they die more or less rapidly in sewage and in river water."

The following opinions on this question of the viability of the typhoid germ by well known authorities are also entitled to much weight:

Dr. C. W. Chancellor: "The microbes of typhoid fever have been observed to live in pure water for thirty days, and three months in water containing one grain of organic matter per quart of water, and their spores very much longer." Rep. Md. State Board of Health, 1887.

Mr. Geo. W. Fuller: "* * * results of long-continued investigations at the Lawrence Experiment Station show that the typhoid bacterium continues to live in the waters of the Merrimac River at

[1] Dr. Samuel Rideal in Journal of the Sanitary Institute, Vol. XIX Part IV.

[2] Dr. Cartwright Wood finds that *B. typhosus* may exist in sea water for at least two months. Report to British Medical Jour., June, 1895.

[3] Report by Lawes and Andrews to the Main Drainage Committee of the London County Council, 1894 (?)

Lawrence, in greatly diminished numbers, for a period of at least twenty-four days." Paper read before the International Public Health Congress, 1893.

Mr. Allen Hazen: "One often hears of the growth of disease germs in water, but as far as the northern United States and Europe are concerned there is no evidence whatever that this takes place. * * The few laboratory experiments which have seemed to show an increase of typhoid germs in water have been made under conditions so widely different from those of natural water courses that they have no value." Filtration of Public Water Supplies, p. 134.

Sunlight appears to be an important agent brought to bear on the destruction of the typhoid bacillus after passing from the outfall into the open water. That this is a fact which should not be ignored is evident from the experiments and testimony of a great number of investigators.[1]

One only, Uffelman, "noticed no injurious action of sunlight upon typhoid bacilli," but "Gaillard, on the other hand, convinced himself that the action of direct sunlight, for from three to four hours, sufficed to destroy completely typhoid bacilli." Janowski found that "typhoid bacilli exposed to direct sunshine were nearly all destroyed in from six to ten hours. Diffused light had a germicide action, though weaker."

"Dieudonné found that the bacillus of typhoid fever and *b. coli* were destroyed in one and one-half hours' exposure to the action of the sunshine."

"Marshall Ward's experiments demonstrated that the actinic rays of the sun, independent of heat, act germicidally."

To illustrate this action, plate cultures of anthrax bacilli with their spores were covered by opaque stencils and exposed to the sunlight. At the end of forty-eight hours the exposed portions remained sterile while the protected portions appeared covered by colonies of bacteria.

Another experiment was made by substituting a photographic negative for the stencil when a positive *bacteria print* was obtained, the bright portions being shown by dense colonies of bacteria.

Further investigation with a spectrum indicated that the germicidal action extended from the green into the ultra violet rays, and by making plate cultures from the offspring of bacilli subjected to sunlight, Marshall Ward traced the enfeebling effect thus produced through several generations. He found, moreover, that the effect of sunlight on spores was even more fatal to their development than to growing bacteria.

1 10th report of the Maine State Board of Health, p. 290 et seq.: also 14th annual report of the Provincial Board of Health of Ontario, p. 8 et seq.

"In 1893, Richardson communicated his observation that, when fresh urine was exposed to the action of direct sunshine and air, there was invariably a formation of hydrogen peroxid which resulted in the destruction of bacteria. Urine thus exposed to the action of the sunlight even showed an antiseptic action when added to other urine that was putrefying and had not been exposed to the action of the sunshine."

"With the view of determining to what extent the action of the sun can be depended upon to disinfect sewage, and what part light plays in the self-purification of rivers, Procaccini carried out a series of investigations. The tables which he presents indicate that the action of the sunlight is strongly bactericidal."

Finally, Professor Buchner ascertained that light exerted a powerful disinfecting action upon the bacilli of typhoid, on *B. coli communis*, on cholera spirilla, and on various bacteria of decomposition when suspended in water. "For instance, water containing 100,000 *B. coli communis* per cc., is rendered completely sterile by one hour's exposure to direct sunshine," while "control samples kept at the same temperature, but not exposed to the light, showed a slight increase in the number of bacteria.

"Even diffused daylight effected a marked diminution in the number of germs after one hour's exposure," from which he concludes that the sunlight "plays an important part in the self-purification of the waters of rivers and lakes." "Even in September and November," he says, "diffused daylight sufficed to destroy, in five hours, bacillus of typhoid fever, *B. pyocyaneus* and *B. coli*."

Supposing, however, that the conditions in a given case will permit one of these typhoid bacilli to survive until brought in contact with a living oyster. Prof. W. K. Brooks of Johns Hopkins University describes the action of the latter as follows:

"Every oyster in the bay is engaged day after day throughout the year, all day and nearly all night, in drawing into its shell a stream of water, filtering this through its gills, and then discharging this stream of water again. * * * After the oyster draws this stream of water into the shell, the water passes through microscopic pores over the surface of the gills, and out again at the vent-pipe. During this process all microscopic life, or most of it, is filtered out . * * * These organisms instead of going through the pores of the gills with the water, are entangled in the cement which the gland cells of the gills are continually pouring out, and they are pushed along into the stomach, where they are ultimately digested and converted into the wholesome substance of the oyster."[1]

[1] Twelfth Bien. report Maryland State Board of Health 1897, pp. 212-213.

We see, thus, that although the tendency seems to be for the typhoid germ to die out both in sewage and in fresh water, its continued existence in pure salt water is as yet problematical; while if placed in sea water containing other organic life we are told that it may exist for an indefinite period. Moreover, we have seen that, if taken in by an oyster, it does not pass through, but is entrapped in its gills as by a filter and finally consumed and transferred into wholesome food, and this without harm to the oyster itself.

It was observed that the oyster "could live for a prolonged period in water opaque with fœcal matter—that from typhoid patients being (no?) more inimical than that from others."

In fact, with the oyster, "all is fish that comes to his net." Though ninety per cent. of his food is said to be composed of diatoms, he is not at all squeamish but absorbs not only bacteria but any minute organic matter at hand, including sewage and even his own offspring, with but little selection.

THE OYSTER AS A MEDIUM FOR THE TRANSFER OF THE TYPHOID BACTERIUM.

According to Dr. Herdman and Prof. Boyce, after being once entrapped by the oyster the typhoid bacillus has shown no disposition to multiply, but decreases in number along the alimentary canal. Dr. Foote states[1] that "if multiplication does occur it takes place within the first two weeks, and that after that there is a progressive decrease in the number of *bacilli typhi abdominalis* found in oysters, but that it may be found even after thirty days from the date of infection, * * * the *bacillus typhosus abdominalis* lives longer in the juice and stomach of the oyster than it does in the water in which the oyster grows." He concludes that "either the juice of the oyster is destructive to certain bacteria or * * * the water undergoes a certain amount of filtration and purification in passing between the shells of the oyster." The latter view coincides with the observation of Prof. Brooks, already referred to.

Herdman and Boyce point out[2] the important fact that by placing the infected oysters in a stream of running water "there is a great diminution or total disapearance of *B. typhosus* * * * in from one to seven days,"[3] and in a monograph of M. Chantemesse on the relation of oysters to typhoid fever, he says, "We are, then, convinced that several days' immersion in pure water will suffice for the oyster to eject all harmful particles that it may contain."

[1] Report State Board of Health of Connecticut, 1895, p. 199.

[2] Nature vol. 55, pp. 105-107 and 293.

[3] See a more reeent paper by the same investigators before the Royal Society, Jan. 19, 1899, in which the bacillus is said to have been recovered up to the tenth day.

It would seem, then, that under certain conditions the typhoid bacillus may survive in the oyster so as to reproduce the disease in man; and we now know this to be a fact. The case at Wesleyan University is well-known where, in 1894, 100 members of certain fraternities held a banquet where raw oysters were served. These oysters had been fattened, 250 to 300 feet from a sewer outfall which discharged typhoid infected excreta. As a consequence, 26 of the above persons contracted typhoid and four died.

At Brighton, England, Dr. A. Newsholme found that 40 per cent. of the typhoid cases originating in 1894, 53 in number, were directly due to contaminated oysters and other shell fish. Nearly all cases were traced to one source. "At this place the condition of things was such that the oysters laid down between high and low water mark were exposed to contamination with sea-water containing large amounts of suspended sewage twice a day, and the mud remaining behind in contact with the oysters showed evidence of the presence of sewage. The sewers discharging near these oysters contained the sewage of several thousand persons."

In the village of l'Herault, France, forty persons partook, in 1896, of raw oysters which had been stored in polluted water. Of these, 14 were taken sick and one died.

In February, 1898, Dr. G. S. Buchanan presented a report upon certain cases of enteric fever alleged to have been contracted by twenty-six persons in various towns of Essex and Suffolk, England. He found:

(1.) That at least 25 cases could be almost certainly ascribed to oysters fattened in Brightlingsea Creek.

(2.) That in at least 20 cases the oysters were taken from two particular beds or "layings" in the said Creek.

(3.) That these two beds were located on the foreshore of Brightlingsea Creek were "conspicuously exposed to pollution" by three sewer outfalls.

(4.) That at sundry periods during the previous year infectious matter from typhoid patients must have been discharged at these three outfalls.

There are other well-authenticated cases on record, but the above serve to show that the possibility of transmission of typhoid fever by subjecting oysters to sewage-polluted water is not to be disputed.

We find, now, that the typhoid bacillus may survive its transit through a sewer to its outfall, and through the water of a river or bay to an oyster bed where it may be retained for some time in the stomach of an oyster; and that this oyster, if eaten raw, may induce typhoid fever in a susceptible subject.

THE PROBABILITY OF TYPHOID INFECTION BY THE OYSTER AND OF ITS TRANSMISSION THEREBY.

But it is of equal importance to ascertain, if we can, the *probability* of infection in any particular situation.

In each of the cases cited, and probably in every case recorded, the oyster bed was subject to gross pollution, being in the immediate vicinity of a sewer outfall. What shall we say now, regarding the conditions existing in the principal oyster grounds of the United States—Narragansett Bay below Providence, Long Island Sound, near the mouth of the Connecticut, the water of New York harbor and of Chesapeake Bay, all of which receive vast amounts of fecal matter?

Judgment has to be passed, it seems to me, on each individual case. If sufficiently remote from the sewer outfall and with sufficient dilution, although we know that infection is *possible,* yet the contingency is so remote that it might perhaps be compared to the danger of losing one's life in traveling on a steam railway. A certain number of casualties of this kind occur each year and yet we do not hesitate to travel on railways in preference to coaches.

Cassedebat was unable to detect the typhoid bacillus in one of 250 cultivations from 70 samples of bad drinking water at Marseilles—"a very hot-bed of water-borne typhoid fever." Oysters have been known to cause typhoid in Naples, but it is a significant fact that after the abandonment of certain infected oyster "reserves" there was no marked alteration in the amount of typhoid in the city, while on the introduction of a better water supply the typhoid deaths fell from 83 to 17 per 100,000, indicating that but little of this disease was attributable to oysters.

Moreover, if we admit for the sake of argument that the problem of transmission of disease by oysters is in reality identical with that of its transmission by drinking water—the water in either case the medium by which such transmission is primarily effected—it may not be out of place here to point out the fact that there are recent indications that the proportion of typhoid cases derived from an impure water supply, although large, is not so great as has been believed by some. The recent experience with typhoid in our army has brought with it the conviction that flies which have had access to fecal matter were in our camps the chief disseminators of the typhoid germ. Dr. M. A. Veeder, in a paper read before the Buffalo Sanitary Club in December, makes the following pointed assertions in this regard: "Contrary to ideas that have existed heretofore, in camps and under similar conditions elsewhere, intestinal diseases are spread almost exclusively by flies, and malarial diseases by water. * * * For example, the outbreak of malignant dysentery mentioned in my paper at the recent meeting of

the American Public Health Association was encountered when at its height, there having been forty cases and ten deaths and the disease spreading rapidly from house to house in a single neighborhood. As soon as measures were adopted such as would make conveyance of the infection by flies impossible, there was not another new case, although there had been fresh ones every day for some time previously. In like manner the past summer a lively epidemic of typhoid fever was ended in a day by measures directed against conveyance by flies. * * * In cities where underground sewers carry such material beyond the ordinary reach of flies, whose migrations are not extensive, such diseases can only become very prevalent through infection of the source of public water supply." *Per contra,* where underground sewers do not exist much of the typhoid originates through the agency of flies.

Reverting, now, to the probability of infection from oysters, we find from the general use of oysters in the raw state and from the fact that, after taken into the system, it takes a fortnight for the germ to produce the disease, it is impossible, or at least very difficult, to trace such infection to its source in the majority of cases. No doubt many deaths from infected oysters occur annually without the least suspicion of the true cause; but I think we may say, from the amount of pollution with which many oyster beds are known to be surrounded, that *the chances of the transmission of disease under ordinary conditions are somewhat remote.*

INVESTIGATIONS AND OPINIONS REGARDING THE SUBJECT IN ENGLAND.

A report by Dr. R. T. Thorne, Medical Officer of the Local Government Board of Great Britain on "Oyster Culture in Relation to Disease" contains, with much other valuable information, a detailed description by Dr. H. T. Bulstrode of the oyster layings in England and Wales, with especial reference to neighboring sewer outfalls. The comments contained therein are of particular interest as an indication of the conditions which are assumed either as dangerous or as unobjectionable.

It was found in discussing the subject that the pits or tanks in which oysters are stored until sent to market should be considered independently of the oyster grounds or layings which either natural beds or those in which the spat are planted. Many of the former were found to be in close proximity to sewer outfalls and were at once condemned as unsafe. Of the latter, from over forty layings or fisheries, seven were found open to objection and in nearly all of these the sewage was discharged within a few hundred feet of the beds.

Now it can be seen from the maps showing the location of the remaining beds that, although certain currents, tides, etc., may render some of these almost entirely free from pollution, yet a reasonable

amount of dilution is all that appears to be required to satisfy the demands of these gentlemen who, as experts, are probably well qualified to judged of such matters. It is to be remarked, also, that in the case of Southend, which is located at the mouth of the Thames, no mention is made of the 250 million gallons of sewage effluent from London alone which is discharged daily some 30 miles above. Had such discharge been considered in the least detrimental it would surely have received notice in this connection.

It is quite clear that *final judgment should be passed only by one possessing at the same time the precise scientific knowledge of the expert and that ability to weigh the more intangible factors of a problem which we call good common sense.*

That this has been the view taken by Dr. Bulstrode is evident from the scope of his investigations, which not only took account of the proximity and amount of any sewage discharge, but of its character, its probable dispersion by river or tidal currents and by what is termed the "mixing" process with sea water, and the viability and probable multiplication of the typhoid bacillus therein. "Obviously," he says "it is possible to reduce to an absurdity the demand for absolute freedom of food supplies from such risks; and to regard, for instance, all articles of food exposed to the ordinary atmospheric conditions of towns as liable to specific contamination, more especially if regard be had to the somewhat cosmopolitan distribution of *bacillus coli.* As regards oysters, it would be not difficult to argue that even deep-sea oyster beds may in the theory not be entirely free from risk of dangerous contamination."

CONCLUSION.

At the same time, it does not take a great deal to convince one of the danger in subjecting oyster beds to the immediate pollution of sewage, and then permitting such beds to be dredged to supply the market. And it is to be hoped that the effect of such investigations as have been referred to will be both to protect our oyster supply from infection by existing sewer effluents and to ensure it against infection from proposed systems of sewerage—by the diversion or treatment of the effluent—provided, always, that the expense of such improvement is not undertaken merely to attain some visionary end or to satisfy some theoretical condition.

That the subject is receiving serious attention both here and abroad by scientists is a sufficient warrant of its importance.

APPENDIX.

EXTRACT FROM THE FIFTEENTH ANNUAL REPORT OF THE PROVINCIAL BOARD OF HEALTH OF ONTARIO.

Dr. P. H. Bryce, Secretary of the Provincial Board of Health of Ontario, arrives at the following conclusions regarding the *B. typhosus:*

"First. There is at least one variety of bacillus, a hemi-parasite, capable of producing typhoid fever.

"Second. That it has extreme varieties in its virulence from a condition where it may apparently live in the digestive tract of man for weeks as a saprophyte, without apparently affecting the general health, to that where taken into the system, as with water, of a vigorous and perfectly healthy young person, it will develop a virulent type of fever within ten days to a fortnight.

"Third. That this virulence is transmitted to the bacillus in such a degree that direct infection by the handling of bed linen, or breathing the air of an infected apartment is not only possible but takes place, if great care is not exercised, with considerable certainty.

"Fourth. That mild types of the bacillus may, living external to the body as saprophytes, notably in shallow wells and in old house drains and gutters, apart from free oxygen and sunlight with abundant nutriment, develop a virulence of a marked character.

"Fifth. That virulent types of the bacillus, passing into the running water of streams, tend to become notably attenuated, unless where carried along during flood times with the organic debris from sewers, ditches and the alluvium and clay which for days together may render such water turbid.

"Sixth. That this saphrophyte, harmless where present in the digestive tract of many healthy persons, may, when mingled with organic material as stable manure, humus, etc., and carried into lakes, pits, wells, etc., notably in winter, when owing to the ice the water has a limited amount of oxygen, develop a virulence capable of setting up fever of greater or less intensity.

"Seventh. That should the general presence of the *bacillus typhosus* in the intestinal tract of man, as a harmless saphrophyte, be denied, then there seems no alternative but to conclude that the *bacillus coli*, which is normally a facultative parasite of the intestinal tract of man and animals, is capable of producing a fever not to be differentiated from that caused by *bacillus typhosus*."

AN EPIDEMIC OF TYPHOID FEVER DUE TO AN INFECTED PUBLIC WATER SUPPLY.

By JOHN LAINY LEAL, A. M., M. D.,

Health Officer, Paterson, N. J.

From September 1st, 1898, to April 1st, 1899, there were reported to the Board of Health of Paterson, N. J., a city of about 110,000 inhabitants, 314 cases of typhoid fever.

From this total is excluded all imported cases (soldiers, those brought from outside the city to the local hospitals, etc.)

Not more than 30 of the whole number of cases could be attributed to any discoverable peculiar or local causes.

The cases were reported as follows:

September	33	cases
October	33	"
November	38	"
December	81	"
January	11	"
February	41	"
March	77	"
Total for the seven months	314	"

In order to appreciate the meaning of these figures it is necessary to compare them with those of the corresponding period of time in previous years.

From Sept. 1st,	1885	to	April 1st,	1886,	there were reported	10	cases
"	"	"	1886	"	"	"	1887	"	"	"	26	"
"	"	"	1887	"	"	"	1888	"	"	"	24	"
"	"	"	1888	"	"	"	1889	"	"	"	42	"
"	"	"	1889	"	"	"	1890	"	"	"	98	"
"	"	"	1890	"	"	"	1891	"	"	"	35	"
"	"	"	1891	"	"	"	1892	"	"	"	37	"
"	"	"	1892	"	"	"	1893	"	"	"	70	"
"	"	"	1893	"	"	"	1894	"	"	"	104	"
"	"	"	1894	"	"	"	1895	"	"	"	42	"
"	"	"	1895	"	"	"	1896	"	"	"	82	"

Total number of cases reported within given seven months of the eleven years taken	570	"
Average number of cases reported within specified seven months for the eleven years taken	51.8	

The increase above the average in the years 1889-1890, 1892-1893, 1893-1894 and 1895-1896, was due to outbreaks in those years from ascertained local causes.

The statistics for the specified periods in 1896-1897 and 1897-1898 are not included in the table, because during both those periods there existed severe general epidemics, the first due to an infected public water supply and the last to an infected milk supply.

It thus appears that from September 1st, 1898, to April 1st, 1899, there were reported about six times as many cases as the average number during the corresponding periods of preceding years.

A closer examination of these figures also shows that within the specified time there appeared two sudden, well-defined and acute rises, exacerabations or crises, viz., December, when 81 cases were reported, and the last week in February and first three in March, when 104 cases were reported. We would therefore seem justified in the claim that a continuous epidemic of typhoid fever, marked by the two well-defined crises mentioned, existed within the limits of the time specified.

An investigation into the clinical history of each individual case showed that 77 of the 81 cases reported in December—the first period of crisis—were infected in the first two weeks of November. Add to these 77 cases 4 of the 11 reported in January, which were infected in the same period, and we have a total of 81 cases infected in the first two weeks of November.

It also showed that of the 104 cases reported during the last week of February and first three in March, 100 were infected in the period composed of the last week in January and the first week in February. Add to these 5 cases reported during last week of March and infected in same period, and we have a total of 105 cases infected in the period composed of the last week in January and the first week in February.

It appears therefore that the period in which the cause of the explosion in December was effective was the first two weeks in November; and the explosion in the period composed of the last week in February and first three weeks of March, finds its cause effective during the period composed of the last week in January and the first week in February.

These were the real periods of crises.

An important feature is common to both these periods, viz., the fact that 75 per cent. of the cases were infected during the first weeks of the respective periods, the second weeks showing a gradual but sharp tapering off.

Now as to the cause of the given phenomena.

Typhoid fever is, as you know, an acute, infectious disease, caused by the entrance into the alimentary canal of a specific bacillus. This bacillus is cast off in the discharges of patients suffering with the disease, and secures entrance into the alimentary canals of others by

means of, first, water; second, milk; third, ice; fourth, food; fifth, other occasional means.

Investigation of the cases under consideration showed them to be scattered about in every section of the city—except one—no section containing an undue proportion.

No point as to position in life, avocation, sex or age (it being understood that typhoid fever is a disease of youth and young adult of life) of those affected arose to attract attention.

There was no common milk, ice or food supply.

No special means of infection could be found.

The only connecting link between the cases possible to discover was the public water supply, which at least 98 per cent. of those affected were known to use for at least a portion of the 24 hours.

The suspicion thus cast upon the public water supply as being the only factor common to the cases was confirmed by the following facts:

FIRST. The only section of the city in which the disease did not appear is the only section not having the public water supply.

SECOND. The city of Passaic, supplied from the same source, was found to be suffering from an outbreak of typhoid fever at the same time.

THIRD. The course of the epidemic was marked by sudden rises and falls.

FOURTH. These rises and falls were preceded by heavy rains and, consequently, rising waters.

You will remember that the period of infection for the first crisis was the first two weeks of November.

The rainfall for the latter half of October was as follows:

October 14th	1.24	inches
" 19th	1.22	"
" 21st	1.45	"
" 22d	.11	"
" 25th	1.03	"
" 30th	.25	"
Total from October 14th	5.30	"
Average rainfall for month of Oct.	4.23	"

The period of infection for the second crisis, you will remember, was composed of the last week in January and the first week in February. The rainfall for January was as follows:

January 6th	1.80	inches
" 13th	.18	"
" 14th	.28	"
" 16th	.44	"
" 24th	1.81	"
" 31st	.10	"
Total rainfall for January	4.61	"
Average rainfall for January	3.96	"

The heavy rainfall of 1.81 inches on January 24th was on top of the greatest snowfall of the season and was followed at once by a general thaw.

From the above facts then it seems reasonable to attribute the source of infection in the outbreak under discussion to the public water supply. The source of said supply for Paterson is the Passaic River; the drainage area of which above the intake is 870 square miles, the average flow 500,000,000 gallons daily, and the rate of flow about 1-6 of a mile an hour. If the theory evolved from the facts given above be true, it follows then that the infection was introduced into the river from some case or cases of typhoid fever, or their results, existing above the intake from some time in the early to the middle part of August, 1898.

It is also reasonable to suppose that certain unusual and peculiar conditions must have accompanied said case or cases of typhoid fever, and such introduction of infection.

The infection of a river of the size and character of the Passaic from a case or two of typhoid to the extent of causing an epidemic, is not a matter of ease or of common or every-day occurrence.

The environment of a few typhoid bacilli, introduced into water of the character and amount of that in the Passiac river above the Great Falls, is so unfavorable as to limit not only their power of reproduction, but their very life, to a few hours, or at the most, days.

The most important factors of this environment are the sunshine, the fresh air, and the constant chemical and bacteriological changes taking place.

The dilution is also so great that it is not reasonable to expect, from such a source of infection, more than a few chance and scattered cases, caused by a few bacilli, of more than average vitality, drawn from the passing current of the river into the mouth of the intake.

To account for a serious and prolonged epidemic or outbreak, it is necessary to show the continuous infection of the river from a large number of cases of typhoid, or a condition which is equivalent to that state of affairs.

In other words, it is necessary to show that, at the proper time or times, typhoid bacilli were introduced into the river in sufficient numbers to reduce the degree of dilution to a point answering the reasonable requirements of the known phenomena.

It is also necessary to show that the point of infection was not so far removed from the intake as to make the time consumed in the passage of the current an unreasonable period for the life of the bacilli, under existing conditions.

That the above propositions are true is not only a matter of general theoretical and practical knowledge, but is supported by our own experience in Paterson.

Since the institution of our local board of health in 1882, there has been only one outbreak which could be attributed to the public water supply, and, according to the best information obtainable, no such outbreak occurred in the twenty-eight years of the existence of the public water supply previous to that time.

Now, it is not reasonable to suppose that, in a watershed of the size and character of that of the Passaic, typhoid infection has not repeatedly occurred; indeed, instances are known in which such infection was introduced into the river, or, at least, in which there was every chance of such introduction.

The unusual and peculiar conditions were not present, however, and no noticeable harm resulted.

In the one outbreak mentioned, on the other hand, and which is supposed to have originated from one case of typhoid, these conditions were present.

The drainage in that case was not direct to the river, but was intercepted by a series of cesspools which discharged into the river. In these cesspools were the conditions essential for the life and multiplication of the specific bacilli, and there existed the same state of affairs as though a large number of cases of typhoid had drained into the river at that point within the same limits of time.

A most thorough search was made over the entire Passaic watershed to find a source of infection which would fulfill the conditions required.

In this search were engaged the state and local boards of health, the state bureau of vital statistics, the various corporations financially interested in the watershed, physicians and private individuals.

Every known case of typhoid fever in the watershed was investigated, and all possible means used for the discovery of unknown ones.

The result was the discovery of but one source of infection which could possibly fulfill the required conditions.

One case of typhoid fever was found to have existed which, with its accompanying conditions, could, in my opinion, account for the outbreak as described above.

A case of typhoid fever developed during the early part of August, 1898. The attending physician made his first visit on August 16th, and found his patient well on into the second week of the disease.

The drainage from the premises of said patient was through a pipe into a small tributary of the Passaic river, about 8,000 feet above the intake. The local board of health, learning of the case on the 23rd of August, at once cut off drainage from said tributary, so that infection directly from said case ceased on that date.

Below the point of entrance of said pipe into tributary, about twenty-five hundred feet, was situated a swamp, which in times of high water

is more or less flooded, and in times of low water contains pools and puddles cut off from the natural low water channel.

The vegetation is rank, thick and tall.

At the head of said swamp is situated a glue and gelatine factory, the drainage of which goes into said tributary and swamp.

The material from which the glue and gelatine was made was also soaked and washed in the waters of said tributary.

Now, on the 10th of August occurred the very heavy rainfall of 2.10 inches, the last of any great amount until the 14th of October following.

The theory, therefore, evolved from these facts, is as follows:

That the said tributary was infected from said case of typhoid while high from the heavy rain of August 10th; that the infected water of tributary spread over said swamp and, falling, left numerous pools, puddles, etc., cut off from the natural channel.

That in these pools, puddles, etc., existed the conditions favorable to the vitality and multiplication of the specific bacilli; these conditions being the low dilution, the unusual amount of organic matter on account of the glue and gelatine factory, the close and rank vegetation, etc.

That a certain number of these bacilli were washed down the river by the rising water following each rain, with a certain amount of damage as a result—the greater the rainfall, the greater the amount of damage done. That the infection of new cases ceased after the first week in Februarv is explained by the fact that the general thaw following the heavy rain of January 24th changed said swamp into a raging torrent, thoroughly washing it out, and keeping its entire area under three to ten feet of water for two to three weeks.

REPORT ON TYPHOID FEVER—NEWARK, N. J.—1898-99.

By Dr. H. C. H. HEROLD,

President Board of Health, Newark, N. J.

Typhoid fever is one of the diseases which destroys life at its most productive period, and it thus lessens the sum total of the earnings of any community. It is generally admitted that one of the best safeguards of a city's health lies in the purity of its water supply. This fact was long ago recognized by our city authorities, and resulted in the purchase of the *"Pequannock Water System."* Beginning its use in April, 1892, we can show a steady decrease in typhoid fever, due mainly to the use of this water. Before this time our source of supply was the Passaic River. If this was shown to be of doubtful quality prior to 1892, it was undoubtedly bad and dangerous to life in 1899, when it was the receiver of the sewage of a half million people discharging daily 70 million gallons of sewage into its waters.

The evidence of the foulness of the water has been pointed out in various ways, not only scientifically by the chemist and bacteriologist, but also,

First. By the stench of its waters.

Second. The death of the fishing industry.

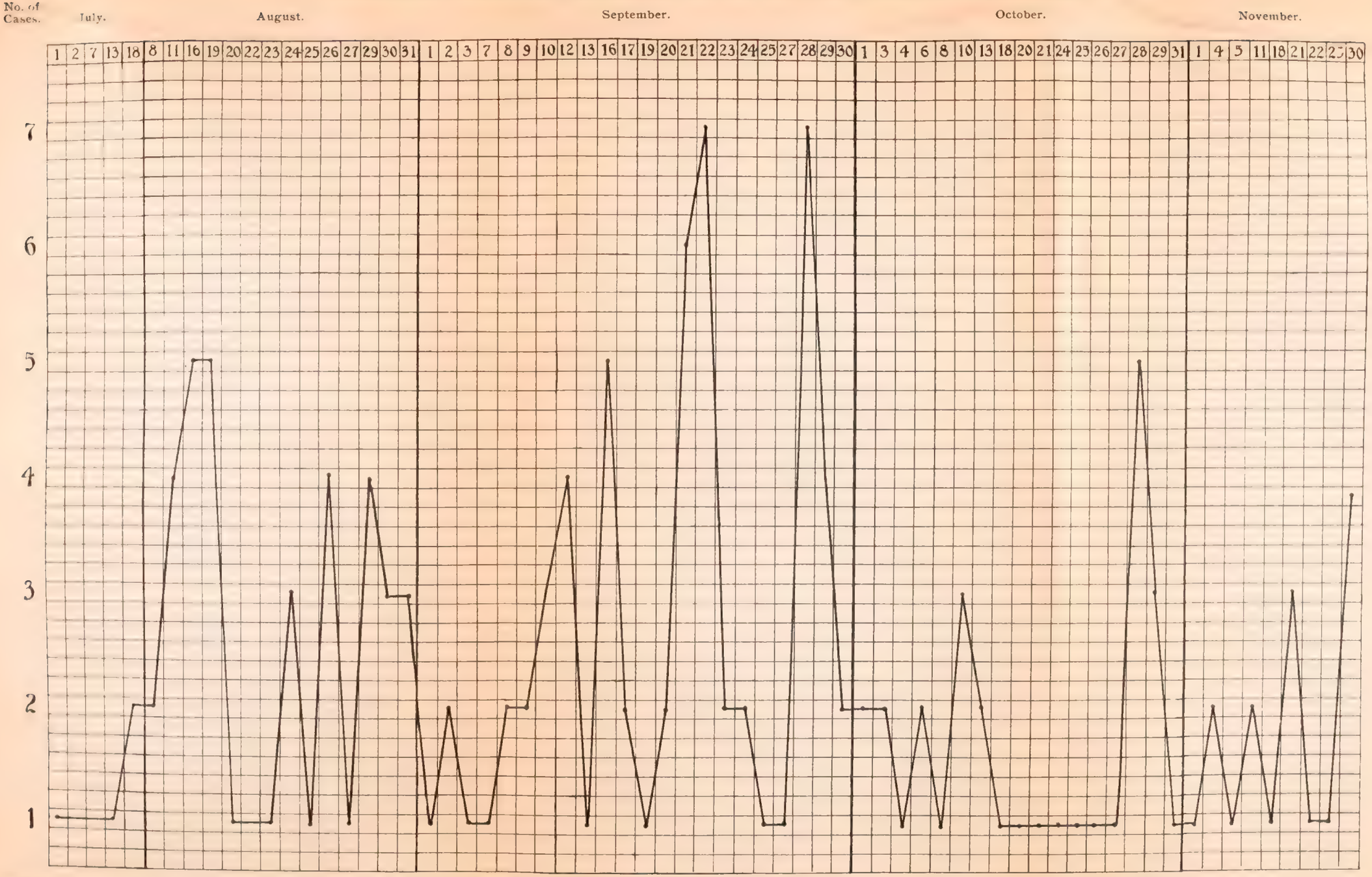
Third. The abandonment of its shores for residential purposes.

We may say in general that any water containing from three grains to ten grains per gallon of sewage refuse, may be considered unfit for use as a potable water. A reference to the report of the Passaic Sewage Commission, 1897, shows in the bacterial tests the constant presence of "coli communis" germs, and these in large numbers. It belongs to a group whose habitat is the intestines, and some of the members of this group are constantly found in the fæces. It is, therefore, the forerunner and also the adjuvant of the diseases of the intestinal type—say cholera and typhoid fever. "The coli communis found in the normal intestine is seen in greatly increased numbers in typhoid fever" (see Albutts practice, page 792.) Some observers like Roux and Rodet believe that the "coli communis" germ, under suitable circumstances, may be converted into the typhoid bacillus.

It is also stated that in ordinary river water the typhoid bacilli rapidly diminish in number.

The presence, therefore, of the "coli communis" germs in large numbers is to our minds sufficient evidence of pollution, and we prefer

A Table Showing Typhoid Fever Cases—Reported Daily from July 1st, 1898, to November 30th, 1898—148 Cases.

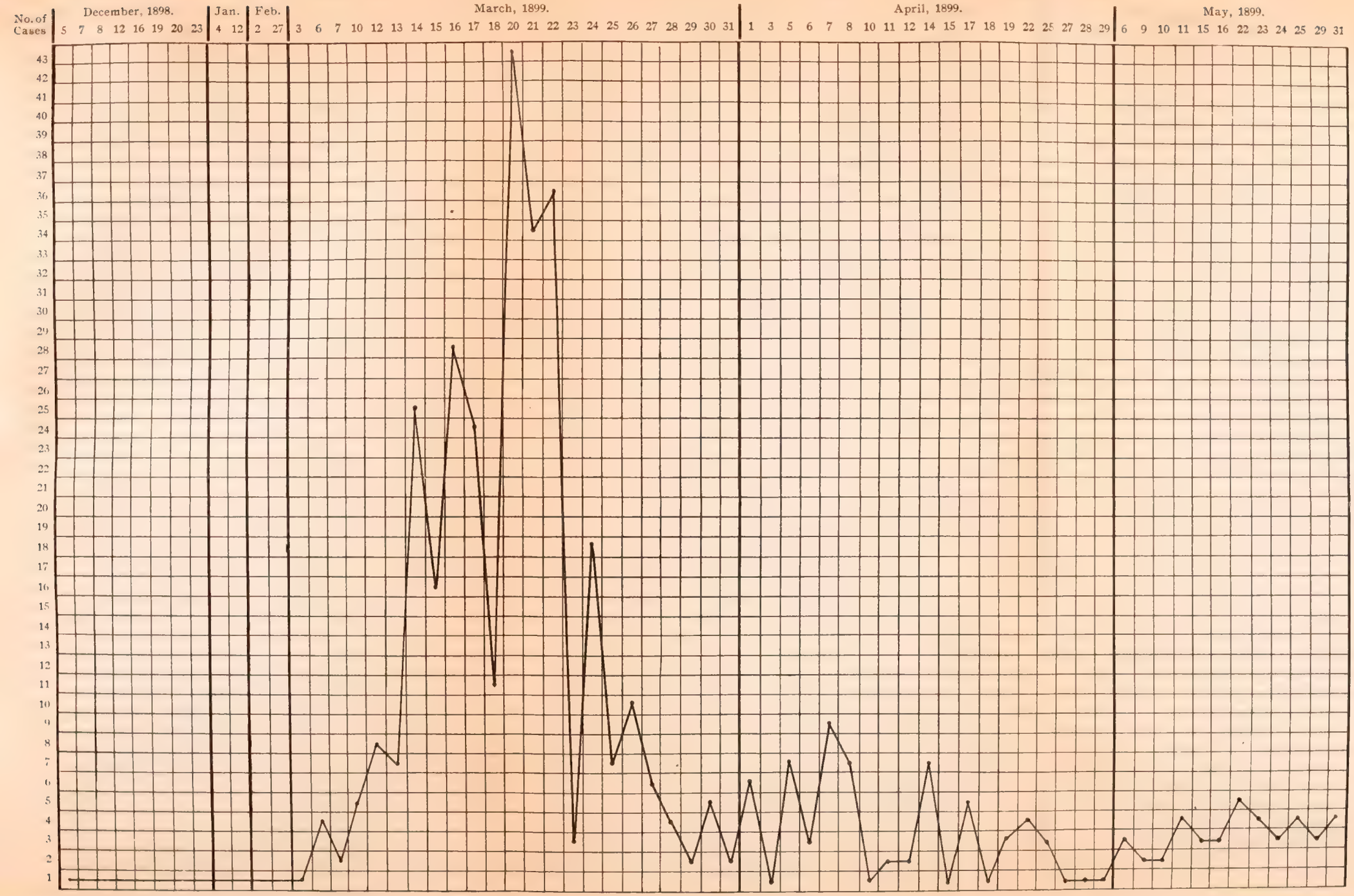


	July.	August.	September.	October.	November.
Totals.	6 1 Soldier.	38 4 Soldiers. 1 Out of town	59 16 Soldiers. 6 Out of town.	29 10 Soldiers. 1 Out of town.	16 3 Soldiers.

Summary.

34 Soldiers.
8 Out of town.
106 City Cases.

TYPHOID FEVER CURVE—DEC. 1st, 1898, TO MAY 31st, 1899. NUMBER OF REPORTED CASES, EACH DAY, SHOWN BY HEIGHTH OF CURVE.



TOTALS.

	Cases.	Deaths.
December, 1898....	8	3
January, 1899....	2	1
February, 1899....	2	0
March, 1899....	301	26
April, 1899...	67	17
May, 1899....	27	7
	407	54

to use it as a standard of warning of things, which, if not actually present, are not far distant, threatening the health of the community.

Keeping in mind the above observations, let us compare them with the results obtained by a series of bacterial tests, 25 in number, taken in the latter half of 1896, at various points along the Passaic River, from Paterson to New York Bay.

25 TESTS—JULY 30, '96 TO NOV. 23, '96.

"Coli Communis" present in 22 tests—Not found in 3 tests
Typhoid germ " " 3 " " " "22 "

Observe that the river is absolutely known to be polluted; that the "coli communis" is present generally in large numbers; that the typhoid germ is difficult to find and we can justly infer that its non-discovery does not negative the dangerous quality of the water.

It was in July, 1898, that we noted an appreciable increase in typhoid fever, rising higher and higher in August and September. A typhoid curve was prepared showing the number of reported cases from July 1, 1898, to November 30, 1898. (See table 1.)

Such a general increase points clearly to a general cause. The majority of outbreaks can be traced to contaminated fluids in general use, such as milk or water. They affect the health of citizens generally. It was suggested that it was due to the soldiers returning from Cuba; therefore a separate account of these was kept. Notwithstanding the exclusion of the soldiers as a factor, a great increase still existed. Repeated examinations of our food and milk supplies did not show sufficient contamination to warrant such an increase. "Enteric fever," due to milk contamination, comes as a rule from some one dairy; the attacks as a rule are simultaneous favoring the younger members of the family (Allbutts practice.)

We turn then to the water supply. It was at once suspected that shortages in the daily Pequannock supply were met by turning in Passaic River water, and this has been admitted. As a result our water supply then became Pequannock water diluted with Passaic River water. We have shown above that Passaic River water is a sewage water, badly contaminated.

In the light of these facts, the numerous cases of diarrhœa and dysentery, intractable to ordinary treatment, a considerable number of which terminated unfavorably, become easily explainable.

Let us examine the "Reported Cases for 1898." The total for the whole year is 179 cases. In the first six months we find only 23 cases. In the last six months 156 cases. Of these 156 cases, there were 126 in three months:

NAMELY—August	38	cases
September	59	"
October	29	"
Total	126	"

In the corresponding months of 1897 32 cases were reported:

NAMELY—August	7	cases
September	14	"
October	11	"
Total	32	"

The average number of cases yearly since 1892 is not much over 100—a fair inference is some pollution, affecting the health of the city at large and introduced some time in July, 1898, raising the reported typhoid cases 80 per cent. to 100 per cent. In November, 1898, 16 cases were reported; December, 1898, 8 cases; in January, 1899, 2 cases; February, 1899, 2 cases—28 cases in 4 months.

In February, 1899, came extreme cold weather; to prevent freezing numerous faucets were kept constantly running; a shortage of water ensued, and the city was face to face with a water famine and a possibility of great loss by fire. Passaic River water was again introduced into our supply (February 13th-18th.) We give the result in our cases:

REPORTED TYPHOID CASES—3 MONTHS.

March, 1899	301	cases
April, 1899	67	"
May, 1899	27	"
Total	395	"

Again comparing these same months in 1898, we have:

REPORTED TYPHOID CASES—3 MONTHS.

March, 1898	2	cases
April, 1898	3	"
May, 1898	3	"
Total	8	"

Comparing deaths for three months in 1898 and 1899:

DEATHS FROM TYPHOID FEVER.

March, 1898	0	March 1899	26
April, "	1	April, "	17
May, "	0	May, "	7
Total	1		50

As we glance over the record of reported cases, we find no *one year* of the years in which our new supply has been in use which can in any way show as many cases as occurred in the *single month of March, 1899.* We agree then with the report of the bacteriologist to the Sewage Commission (P. 82, report 1897), who says: "The water of the river is as foul as it possibly can be; its deposit contains elements, which when introduced into the body, are absolutely dangerous to life."

In a monetary estimate, considering loss of time, expenses, etc., we could easily approach half a million dollars; and between the loss by fire of a half a million in property and the loss of a half million by damage to human health and life, there can be but one choice.

LOW PRESSURE DISTRICT—SECTION EAST OF DIVISION LINE.

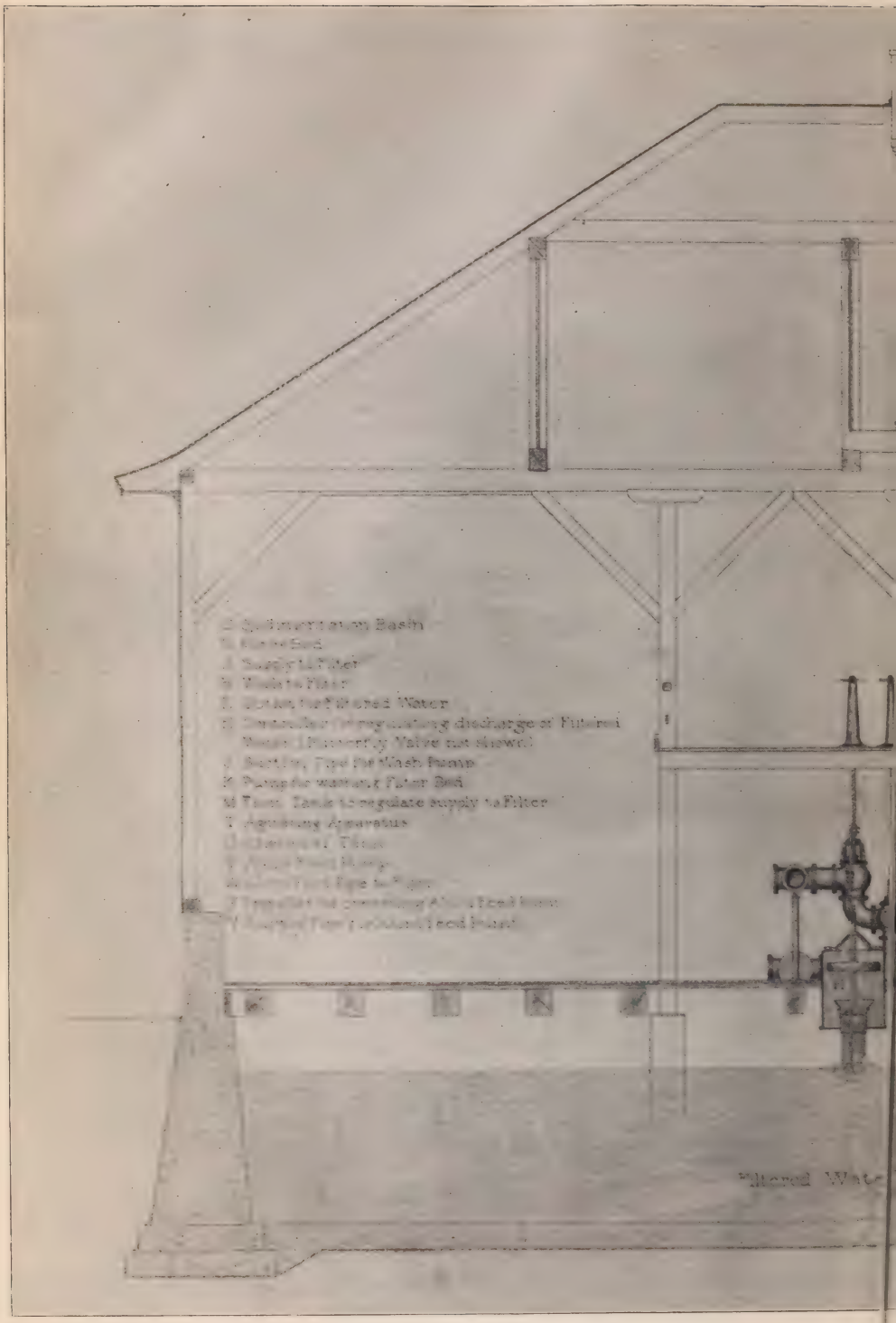
Beginning at Second River, Summer Ave. to Fifth Ave. to Stone St., Crane, Wood, Sheffield, Eighth Ave., Boyden St. to Orange St., High St., Springfield Ave., Market St., Arlington St., Coes Place to Baldwin St., Washington St., Clinton Ave. to Elizabeth Ave.

TABLE SHOWING TOTAL DAILY CONSUMPTION AND ALSO DAILY AMOUNT PASSAIC RIVER WATER USED FEBRUARY 7—18, 1899.

Date	Total Daily Consumption.	Passaic River Water
February 7	27,800,000 gallons	
" 8	34,800,000 "	
" 9	40,200,000 "	
" 10	42,200,000 "	
" 11	40,800,000 "	
" 12	36,700,000 "	
" 13	39,200,000 "	3,600,000 gallons
" 14	39,200,000 "	14,700,000 "
" 15	39,500,000 "	17,800,000 "
" 16	37,900,000 "	16,200,000 "
" 17	32,500,000 "	8,100,000 "
" 18	30,500,000 "	2,600,000 "
Total consumption Feb. 13-18	218,800,000 "	
Total Passaic River Water		63,000,000 "

REPORTED TYPHOID FEVER CASES—1887 TO 1899.

	Jan.	Feb.	Mch.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Tot'ls
1887	10	14	6	3	7	3	8	20	17	13	13	9	123
1888	14	13	14	13	4	8	10	33	45	49	32	67	302
1889	56	21	17	11	8	8	15	26	22	57	94	203	538
1890	93	23	21	17	16	7	20	10	22	27	34	57	357
1891	88	42	43	18	18	11	15	167	207	137	92	38	876
1892	36	27	19	11	4	4	16	32	30	17	16	17	229
1893	5	3	9	6	8	10	11	26	12	21	7	7	125
1894	2	4	6	9	6	3	3	10	13	21	6	5	88
1895	3	3	2	1	6	4	4	31	38	21	21	15	149
1896	10	4	3	2	3	6	4	14	25	29	7	8	115
1897	5	5	11	7	5	2	8	7	14	11	13	15	103
1898	5	3	2	3	3	7	6	38	59	29	16	8	179
1899	2	2	301	67	27	9	19	28	30	....	....	....	485



New York Filter Mfg. Co.

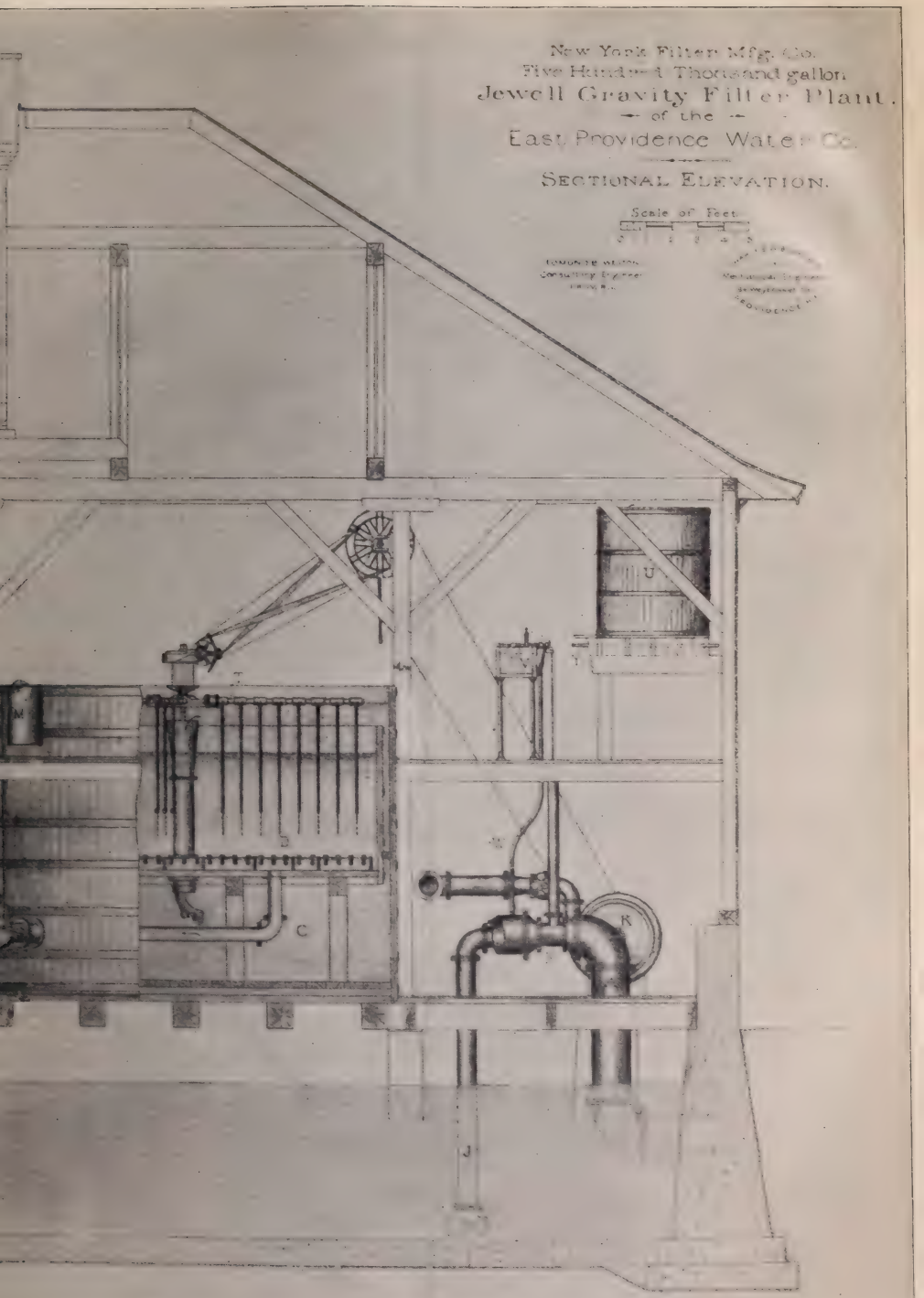
Five Hundred Thousand gallon

Jewell Gravity Filter Plant.

— of the —

East Providence Water Co.

Sectional Elevation.



A REPORT OF A FOUR MONTHS' TEST OF A MECHANICAL FILTER PLANT AT EAST PROVIDENCE, R. I.

By GARDNER T. SWARTS, M. D.,

Secretary State Board of Health, Providence, R. I.

I desire to report the result of a test of a mechanical filtration plant, located at East Providence, in the State of Rhode Island:

The supply of a portion of this town is taken from the Ten Mile River, which is a stream of about twelve miles in length. It rises in the State of Massachusetts, and has on its borders several towns and a large number of jewelry manufacturies, woollen mills, and dye houses. The wastes from all of these deliver directly into the river, and the river receiving the wastes from a population of 3,700.

It was impossible for the State of Rhode Island to require a discontinuance of the pollution of the river, and the State of Massachusetts apparently had no authority in the matter. A civil suit, brought by the water company, against each polluter, would be the only means of enjoining against pollution. This would not only be expensive, but would require years of litigation before final removal of every source of pollution. It was therefore necessary that some immediate action be taken and the supply, with its pumping station and mains, condemned and abandoned, or the water purified, as far as practicable, before delivering the supply to the consumers.

Upon request of the management of the company for advice from the State Board of Health, the mechanical, or American, filtration method was recommended. This advice was given in preference to the use of the natural sand bed filtration on account of the location of the pumping station; the necessity of covering the beds in this climate, which would add materially to the original cost; for the purpose of removing completely the coloring matter which was found in the supply, and from the satisfactory and perfect control and celerity of cleansing to be found in the mechanical form of filtration.

The plant, while not a large one, yet consists of one initial of the type known as the "Jewell Gravity Filter" and supplied by the New York Filter Manufacturing Company, of New York.

In case a larger supply was required, it would be only necessary to repeat this initial size of filter indefinitely, therefore, the work of one initial would be the same as a number, although the water company, at the present time, is supplying but 200,000 gallons of water to its consumers. The daily capacity of the filter is available to 500,000

gallons at the rate of filtration of 125,000,000 gallons per acre per 24 hours.

The tests covered a period of about 144 days, or four months, and the operation of the filter was under the charge of the regular pumping engineer of the Water Company. The quantities of sulphate of alumina used were weighed out by him under advice of Mr. E. B. Weston, C. E., who also planned and superintended the construction of the whole plant.

The chemical analyses in the test were made by Prof. John Howard Appleton, of Brown University.

The bacterial analyses, as well as the determination of color and alkalinity, were made by the writer.

The precipitant, or coagulant, or chemical used throughout the test was sulphate of alumina, which was dissolved in the proportions of one part of sulphate of alumina in about 20 parts of filtered water. This solution was made about twenty-four hours before being used, the supply for the day's run being taken from a second tank in which the alumina had been dissolved the day before.

The sulphate of alumina used contained about 22 per cent. of alumina (AL_2O_3), except from March 10th to 11th, inclusive; from June 1st to 7th, inclusive and from June 27th to 28th, inclusive, when an inferior and cheaper grade, containing about 17.53 per cent., was used. The object in using this inferior grade was to determine if the same, or increased, quantities of sulphate of alumina might not give equally good results with less cost. It was found, however, that the increase in quantity brought the expense to equal the cost of smaller quantities of the expensive sulphate of alumina, the maximum efficiency depending upon the amount of the alumina (AL_2O_3) in the applied chemical.

Sulphate of alumina was added to the raw water at the rate of one grain per gallon except from March 10th to 11th; March 20th to 25th, and from May 1st to 6th, when 0.75 of a grain was used; March 27th to 30th, when 0.6 was used, and from June 22d to 28th, when 1.25 grains were used. These variations were naturally made to determine the minimum amount of the applied chemical which would give maximum efficiency.

The average removal of bacteria during the test, including the use of the inferior grades and the increased quantity of sulphate of alumina, was 98.7 per cent. The average removal of bacteria was 99.2 per cent. during the time when one grain of sulphate of alumina of the higher grade which contained 22 per cent. of alumina (AL_2O_3), was used.

Ten per cent. gelatine was used in the bacteriological test, and the plates exposed to ordinary refrigerator temperature, the period of

growth being from four to six days according to the variation of the external temperature.

The sample of applied water was taken from the mains within a few feet of the sediment chamber, the sulphate of alumina being introduced by means of a (so-called) Egyptian pump whose movements were controlled by a propellor in the supply main) a short distance beyond the point from where the supply was taken.

The effluent, or filtered, sample was taken a few feet distant from the outlet of the filter.

As the result of the computations made by Mr. Weston, the chemical results show that there was:

Six per cent. less total solids in the filtered water than there was in the raw water.

One per cent. less chlorine in the filtered water.

Sixty-one per cent. less ferric oxide in the filtered water.

Thirty-eight per cent. less aluminic oxide in the filtered water.

Twenty-nine per cent. less free ammonia in the filtered water.

Sixty-three per cent. less albuminoid ammonia in the filtered water.

Eighty-three per cent. less color in the filtered water.

Twenty per cent. increase of hardness in the filtered water.

The filtered water in every instance was alkaline.

Attention is called to the fact that the preceding summary of results shows that the filtered water contained 38 per cent. less alumina than did the raw water before the sulphate of alumina was added to it.

It is customary to give the results of the removal of bacteria in percentages, the efficiency or removal being computed in that proportion.

In making a proposition for satisfactory filtration, it is sometimes stated that an average efficiency of 98 or 99 per cent. removal will be guaranteed. It seems to the writer that such an indicator, although mathematically correct, is not fair to the operation of a given plant.

As an illustration, if the effluent shows the presence of ten organisms to the cubic centimeter of water tested, and the applied water contained one thousand, an efficiency of 99 per cent. is attained, but should there be but one more organism in the count of the effluent, or eleven, the percentage would drop to 98.98 per cent., or below a guarantee of 99 per cent. The same drop from 99 per cent. would occur if there was one less organism in the applied water, giving an efficiency of only 98.99 per cent.

When, as it sometimes occurs, there is an increase in the applied water from the average of one or two hundred, to up into the thousands, the effluent does not show any such increase over the two or ten as the case may be. There is not the proportionate increase in the

effluent, that we should look for, and yet this is not apparent when we consider the results of percentages. This is especially evident when we study the filtration of sewage wastes, where we deal with millions in the applied water and have only hundreds in the effluent, the efficiency being apparently exceedingly high when judged by percentage.

Again, although a filter may be giving its average efficiency in the effluent, say, of ten, should the applied water drop to two hundred, there is a great drop in the efficiency and yet the water which we are to supply to the consumer is of no worse quality than when we were treating the filter with a supply having a high count.

It would seem fairer and more satisfactory to speak of the efficiency of a filter as being one which will give an average effluent count of not over a certain number under the conditions of an applied water which shall not have a count lower than a certain high maximum. These conditions would be more satisfactorily attained and would appear more applicable to the conditions of efficiency than by comparison of percentages.

Another illustration may be seen in cases, where of two filters, the second gives a lower count in the effluent than the first; yet the first will give apparently increased percentage of average efficiency over the second, simply on account of a large increase in the numbers of the applied water.

In other words, all other requirements being equal, we should favor the process, whatever it may be, that is going to give us the purest water bacteriologically, regardless of the amount of impurity of the original supply.

It may be stated that no complaint has been received from any consumer concerning the increase in hardness, which naturally comes with this method of treatment, but commendation has been given for the whiteness of the water.

The apparent increase in hardness is in fact more a matter of chemical computation than any actual change which can be perceptible to the ordinary senses and physical functions of persons, or which may be noticeable to the producers of steam. Should any objection exist in the use of this water for the production of steam, there will be available an excellent opportunity to determine that fact through the present use of the water in iron condensing vats in a certain chemical manufactory which is attached to this supply.

The following tables give briefly the chemical and bacteriological results of this short run, under actual conditions of supply to the consumers:

TABLE No. 1.

TEST OF THE EAST PROVIDENCE MECHANICAL FILTER.

CHEMICAL ANALYSES OF SAMPLES.

BY PROFESSOR JOHN HOWARD APPLETON.

Rate of Filtration, 125,000,000 Gallons per Acre per 24 hours.

The numbers express parts (by weight) in one million parts of water, (by weight).

DATE		Total Solids	Total Hardness.	Chlorine	Ferric Oxide	Aluminic Oxide	N. as Free Ammonia	N. as Albuminoid Ammonia	N. as Nitrates	N. as Nitrites
RAW WATER.										
March	9	36.4	15.0	3.0			0.01	0.16	0.70	Trace
"	30	36.7	15.0	2.1	0.42	1.23	0.06	0.14	0.60	"
April	6	39.0	16.0	4.8	0.58	0.47	0.04	0.22	0.60	"
"	13	39.3	14.0	7.0	0.60	0.80	0.10	0.26	0.90	"
"	20	39.9	17.0	6.4	0.61	1.05	0.05	0.26	0.70	"
"	27	43.7	18.0	6.2	1.00	0.75	0.02	0.22	0.70	"
May	4	51.5	17.0	6.8	0.98	1.67	0.03	0.28	0.60	"
"	11	53.1	21.0	6.4	0.91	1.84	0.03	0.38	0.60	0
"	18	54.9	21.0	6.1	1.01	0.34	0.03	0.34	0.60	Trace
"	25	49.6	20.0	6.4	1.09	0.76	0.04	0.32	0.60	"
FILTERED WATER.										
March	9	32.2	17.0	3.0			0.03	0.07	0.60	Trace
"	30	30.7	18.0	4.0	0.18	0.97	0.04	0.10	0.50	"
April	6	38.9	22.0	4.8	0.61	0.44	0.04	0.10	0.60	"
"	13	40.4	19.0	6.0	0.45	0.55	0.05	0.11	0.70	"
"	20	37.4	22.0	6.4	0.28	1.02	0.05	0.10	0.60	"
"	27	39.6	19.0	6.2	0.19	0.26	0.01	0.07	0.60	"
May	4	49.5	22.0	7.7	0.42	1.08	0.02	0.11	0.60	"
"	11	47.2	23.0	6.3	0.20	0.55	0.02	0.14	0.40	0
"	18	49.8	23.0	5.8	0.13	0.47	0.03	0.12	0.50	Trace
"	25	46.5	24.0	7.2	0.40	0.45	0.02	0.13	0.60	"

TABLE No. 2.

TEST OF THE EAST PROVIDENCE MECHANICAL FILTER.

BACTERIOLOGICAL ANALYSES OF SAMPLES.

Rate of Filtration, 125,000,000 Gallons per Acre, per 24 hours.

DATE		Bacteria per cubic centimetre		Per cent of Reduction.	Grains of Sulphate of Alumina per Gallon.
		Raw Water	Filtered Water		
March	10	954	55	94.24	0.75*
"	11	480	47	90.21	0.75*
"	13	768	4	99.48	1
"	14	595	5.5	99.08	1
"	15	Sterilized filter bed			
"	16	1299	9	99.31	1
"	17	1257	7	99.45	1
"	18	683	4	99.41	1
"	20	658	7	98.94	0.75
"	21	1888	26	98.62	0.75
"	22	1044	31	97.03	0.75
"	23	1550	37	97.61	0.75
"	24	3652	51	98.60	0.75
"	25	1818	16	99.12	0.75
"	27	512	11	97.85	0.60
"	28	1142	6	99.47	0.60
"	29	1025	4	99.61	0.60
"	30	822	16	98.05	0.60
"	31	782	1.5	99.82	1
April	1	499	7	98.60	1
"	3	636	1.5	99.76	1
"	4	628	2	99.68	1
"	5	545	4	99.27	1
"	6	855	3	99.65	1
"	7	1910	19	99.01	1
"	8	1009	6.5	99.36	1
"	10	1175	6.5	99.45	1
"	11	943	9.3	99.01	1
"	12	1443	9	99.38	1
"	13	336	4.3	98.73	1
"	14	Lost.	4		1
"	15	998	1.6	99.84	1
"	17	765	7.5	99.02	1
"	18	578	6.3	98.91	1
"	19	865	11	98.73	1
"	20	546	3	99.45	1
"	21	699	2	99.97	1
"	22	359	3	99.17	1
"	24	293	3	98.98	1
"	25	697	0.5	99.93	1
"	26	724	11	98.48	1
"	27	422	9	97.87	1
"	28	280	2.5	99.11	1
"	29	370	6	98.38	1
May	1	370	4.5	98.78	0.75
"	2	469	8	98.30	0.75
"	3	403	13	96.77	0.75

* Inferior grade of sulphate of alumina having a relative value of about 80 per cent of the sulphate of alumina used at other times.

TABLE No. 2.—CONTINUED.

DATE		Bacteria per cubic centimetre.		Per cent of Reduction.	Grains of Sulphate of Alumina per Gallon.
		Raw Water	Filtered Water		
May	4	289	61	78.89	0.75
"	5	310	6	98.07	0.75
"	6	316	21	93.35	0.75
"	8	266	9	96.62	1
"	9	976	3	99.69	1
"	10	708	13.5	98.09	1
"	11	150	5	96.66	1
"	12	466	3.5	99.25	1
"	13	305	4	98.69	1
"	15	225	1	99.56	1
"	16	238	0.5	99.79	1
"	17	306	0.5	99.83	1
"	18	473	0	100.00	1
"	19	210	0.5	99.76	1
"	20	228	1	99.56	1
"	22	238	0.5	99.79	1
"	23	279	1	99.64	1
"	24	228	1	99.56	1
"	25	275	0	100.00	1
"	26	270	0.5	99.81	1
"	27	185	1	99.46	1
"	29	454	4.5	99.01	1
"	30	334	11.5	96.56	1
"	31	458	10	97.82	1
June	1	1478	10	99.32	1*
"	2	387	16	95.87	1*
"	3	411	21	94.89	1*
"	5	548	18	96.72	1*
"	6	434	23	94.70	1*
"	7	587	10	98.30	1*
"	8	331	4	98.79	1
"	9	494	8.5	98.28	1
"	10	341	6.3	98.15	1
"	12	354	0.3	99.92	1
"	13	243	2	99.18	1
"	14	181	0.3	99.83	1
"	15	265	1	99.62	1
"	16	388	0.6	99.85	1
"	17	277	2.5	99.10	1
"	19	Lost.	14		1
"	20	233	8	96.56	1
"	21	291	4.3	98.52	1
"	22	175	2.3	98.69	1.25*
"	23	162	1	99.38	1.25*
"	24	276	2.3	99.17	1.25*
"	26	416	3.3	99.21	1.25*
"	27	226	3.6	98.41	1.25*
"	28	242	1.6	99.34	1.25*
"	29	2096	4	99.81	1
"	30	849	4	99.53	1
July	10	2026	5.6	99.72	1

* Inferior grade of sulphate of alumina having a relative value of about 80 per cent of the sulphate of alumina used at other times.

TABLE No. 2.—CONCLUDED.

DATE		Bacteria per cubic centimetre		Per cent of Reduction.	Grains of Sulphate of Alumina per Gallon.
		Raw Water	Filteerd Water		
July	11	321	11	96.57	1
"	12	398	12	96.98	1
"	13	262	20	92.37	1
"	14	402	5	98.76	1
"	15	148	1.6	98.92	1
"	17	383	5.6	98.54	1
"	18	279	0	100.00	1
"	19	225	1.6	99.29	1
"	20	86	2.3	97.32	1
"	21	365	8.3	97·73	1
"	22	764	3	99.61	1
"	27	175	0.6	99.66	1
"	28	159	4.6	97.11	1
"	29	473	2.3	99.51	1
"	31	444	1.3	99.71	1
Aug.	1	424	1	99.76	1
"	2	313	2	99.36	1

TABLE No. 3.

TEST OF THE EAST PROVIDENCE MECHANICAL FILTER.

COLOR OF SAMPLES.

Rate of Filtration, 125,000,000 Gallons per Acre per 24 hours.

The unit of color is practically that color yielded by properly nesslerizing 50 cubic centimetres of water containing one one-hundredth of a milligram of ammonia gas (or its equivalent).

DATE.	Raw Water.	Filtered Water.	Grains of Sulphate of Alumina per Gallon.	DATE.	Raw Water.	Filtered Water.	Grains of Sulphate of Alumina per Gallon.
Mar. 10	.50	.10	0.75*	Apr. 21	.60	.10	1
" 11	.50	.10	0.75*	" 22	.60	.10	1
" 13	.50	.10	1	" 24	.60	.10	1
" 14	.50	.10	1	" 25	.60	.10	1
" 15	Sterilized filter-bed.			" 26	.60	.10	1
" 16	.50	.10	1	" 27	.70	.10	1
" 17	.50	.10	1	" 28	.70	.10	1
" 18	.50	.10	1	" 29	.60	.10	1
" 20	.50	.10	0.75	May 1	.60	.10	0.75
" 21	.50	.10	0.75	" 2	.60	.10	0.75
" 22	.50	.10	0.75	" 3	.70	.10	0.75
" 23	.50	.10	0.75	" 4	.70	.10	0.75
" 24	.40	.10	0.75	" 5	.70	.20	0.75
" 25	.40	.10	0.75	" 6	.70	.40	0.75
" 27	.40	.10	0.60	" 8	.70	.10	1
" 28	.30	.10	0.60	" 9	.70	.10	1
" 29	.40	.10	0.60	" 10	.70	.20	1
" 30	.40	.10	0.60	" 11	1.00	.10	1
" 31	.40	.10	1	" 12	1.00	.10	1
Apr. 1	.40	.10	1	" 13	.90	.10	1
" 3	.40	.10	1	" 15	.80	.10	1
" 4	.40	.10	1	" 16	.90	.10	1
" 5	.40	.10	1	" 17	.80	.10	1
" 6	.40	.10	1	" 18	.80	.10	1
" 7	.40	.10	1	" 19	.70	.10	1
" 8	.40	.10	1	" 20	.70	.10	1
" 10	.50	.10	1	" 22	.70	.10	1
" 11	.40	.10	1	" 23	.60	.10	1
" 12	.50	.10	1	" 24	.60	.10	1
" 13	.50	.10	1	" 25	.70	.10	1
" 14	.50	.10	1	" 26	.60	.10	1
" 15	.50	.10	1	" 27	.60	.10	1
" 17	.50	.10	1	" 29	.60	.10	1
" 18	.60	.10	1	" 30	.60	.10	1
" 19	.60	.10	1	" 31	.50	.10	1
" 20	.60	.10	1				

* Inferior grade of sulphate of alumina having a relative value of about 80 per cent of the sulphate of alumina used at other times.

TABLE No. 4.

TEST OF THE EAST PROVIDENCE MECHANICAL FILTER.

ALKALINITY OF SAMPLES.

Rate of Filtration, 125,000,000 Gallons per Acre per 24 hours.

(The Alkalinity is expressed as Calcium Carbonate, in Parts per 1,000,000.)

DATE	Raw Water	Filtered Water	Grains of Sulphate of Alumina per Gallon	DATE	Raw Water	Filtered Water	Grains of Sulphate of Alumina per Gallon
March 10	6.4	2.3	0.75*	April 21	11	4.5	1
" 11	6.0	2.7	0.75*	" 22	8.5	4.7	1
" 13	5.5	1.7	1	" 24	14	7	1
" 14	7.5	2	1	" 25	14	7	1
" 15	Sterilized filter bed.			" 26	14	6	1
" 16	6.7	1.5	1	" 27	14	6	1
" 17	7	2	1	" 28	14.5	6	1
" 18	6.7	2	1	" 29	13.5	6	1
" 20	6.2	1.7	0.75	May 1	14.5	7	0.75
" 21	7.7	1.5	0.75	" 2	15	8	0.75
" 22	6.5	2	0.75	" 3	13.5	7.5	0.75
" 23	5.5	1.7	0.75	" 4	15	7.5	0.75
" 24	6	2	0.75	" 5	14	6.5	0.75
" 25	5.7	1.5	0.60	" 6	15.5	6.5	0.75
" 27	7.2	3	0.60	" 8	15	6.5	1
" 28	9	4	0.60	" 9	14.5	6	1
" 29	6.5	3	0.60	" 10	15	6	1
" 30	7.7	3.5	0.60	" 11	14	6	1
" 31	9	2.7	1	" 12	14.5	6.5	1
April 1	8.5	3	1	" 13	14.5	5.5	1
" 3	9.2	2.7	1	" 15	15	5.5	1
" 4	9.5	3.2	1	" 16	14	5	1
" 5	8.7	3.2	1	" 17	14.5	6.5	1
" 6	6.5	3	1	" 18	14.5	6	1
" 7	11	3.7	1	" 19	14	6	1
" 8	10	3.2	1	" 20	14.5	6	1
" 10	9	3.7	1	" 22	14	8	1
" 11	10.5	3.2	1	" 23	14	6	1
" 12	11	4	1	" 24	14	7	1
" 13	10.2	Lost.	1	" 25	14	7	1
" 14	11.5	4	1	" 26	15	6	1
" 15	11.5	5	1	" 27	14.5	5	1
" 17	12	4.5	1	" 29	14	5	1
" 18	11	4	1	" 30	14	5	1
" 19	11	4.5	1	" 31	14.5	6	1
" 20	12	2	1				

* Inferior grade of sulphate of alumina having a relative value of about 80 per cent of the sulphate of alumina used at other times.

THE BACTERIAL PURIFICATION OF SEWAGE.

By H. W. CLARK,

Chemist of the Massachusetts State Board of Health and in Charge of Lawrence Experiment Station.

Mr. President and Fellow-Members of the Association.—I have been asked to contribute a few remarks to this meeting upon the subject of the bacterial purification of sewage. This is a subject with which I am somewhat familiar, owing to my connection for the past eleven years with the work of the State Board of Health of Massachusetts, and their various investigations upon methods of sewage disposal or purification, made at the Experiment Station at Lawrence and elsewhere in the State. Most of these investigations can be classed under the general head of experiments upon purification of sewage by intermittent filtration, but beyond that, especially of late years, many modifications of the intermittent sand filter method have been studied, with an especial view to obtaining data upon methods of concentrating the area necessary for the satisfactory and economical purification of large volumes of sewage.

These studies upon concentrated purification have not, however, been carried on upon so large a scale in Massachusetts as in England during the past few years; the reason being that the conditions existing in Massachusetts and in England are entirely different. In England, owing to the density of the population, the high price of land, and the clayey nature of the soil, the sewage disposal problem confronted there by many municipalities has necessitated the appropriation of large sums of money by them, and the prosecution of investigations upon a fairly large scale under the direction of some of the ablest engineers and chemists of the country, at many places, under many conditions, with different kinds of sewage, and with an eager search for the best artificial materials for filter beds and the best methods of operation to achieve high rates. In our own country for many years the only place where systematic studies of sewage purification were made was the Lawrence Experiment Station, and even now it would be difficult to name any other place where the investigations along this line are seriously pursued year after year. Extensive engineering studies of the disposal of sewage of large communities by running it out to sea or down some large river have, of course, been made; but where is the American municipality, with the exception of Worcester, Massachusetts, that has for a number of years made studies with both engineers

and chemists of the question of the purification of its sewage? In fact, difficult problems of sewage purification have not presented themselves as yet to inland cities and towns in Massachusetts, if we except Worcester already mentioned, and the studies at the Experiment Station upon concentrated purification have been carried on simply with an eye to the future, or in preparation for the unexpected appearance of a problem to be solved only by some concentrated method.

All true sewage purification is, in some of its features at least, bacterial purification, although the work of the bacteria may be lessened by mechanical contrivances or by the addition of chemicals to partially clarify the sewage before it is turned over to the silent but efficient workers who complete the change so necessary for complete purification.

At the present day it would seem hardly possible, with the accumulated studies of the country and of England upon this subject, that anyone should question the great part that bacteria play in changing organic matter to inorganic forms. Early in the present century—that is, in 1838—the discovery was made that yeast was a living plant, and that putrefaction was caused by something in the air which heat could destroy. As early as 1872 Frankland declared that a water filter must not be considered as a mere mechanical contrivance, the process being carried on being also a chemical one; and researches soon after by various scientists, especially Warrington, Schlossing and Winogradsky, made clear that the purifying action of soil upon organic matter was due to an organism which changed this organic matter to the inorganic form. In 1872, according to a statement of Dr. Rideal, the Berlin Sewerage Commission first reported that sewage matter was converted into nitrates in passing through the soil, not by a simple mechanical or chemical process but by the aid of organisms always present in sewage and soil.

The laboratory investigators in the last twenty-seven years have been numerous, and their investigations many and widely published, yet even at the present time we find that the theory of the purification of sewage by bacteria is not everywhere accepted as conclusively proved. One of the latest books upon sewage and sewage analysis, which has come to my laboratory and written by Wanklyn, to whom we sanitary chemists have been indebted these many years for his method of determining free and albuminoid ammonia in water and sewage, states that "One of the fashionable delusions of the day is that the oxidation of organic compounds demands the presence of living organisms in order that it may be accomplished." "This fashionable fad of the day," he says, "owes its existence to a curious ignorance or obliviousness and denial of some of the oldest and best established

truths of chemistry." Happily, however, for the progress of the science, the opinion of Mr. Wanklyn is not generally held; in fact, I may say it is held by no one who has given this subject of purification much study or thought; especially it cannot be held by one who for many years has seen the necessity of encouraging the action of bacteria in all sewage filters of whatever substance they are built or however operated.

Let us for a few moments consider in an elementary way what sewage is and what changes must take place in order to purify it. Domestic sewage, as it enters the sewers of a town or city, consists of organic matter, mineral matter and water. It is evident that with a given population the strength of the sewage produced by a town, or in other words, the degree of pollution of the water flowing in its sewers, varies inversely as the body of water used by that population. It is generally much more dilute in American than in European cities and towns, owing largely to the extravagant water consumption of the average American municipality.

When the mixture of water and organic and mineral matters of various kinds has just occurred, the sewage is quite different in its general composition, as shown by analysis, from the same sewage after the elapse of a number of hours. The fresh sewage—that is, the sewage just as it enters the sewers from houses or streets—contains free oxygen and generally nitrates and nitrites from the water supply and ground water, and the proportion of organic matters in suspension to those in solution is comparatively large. Now, if a portion of this fresh sewage is sterilized by heat, or if it is sterilized by a chemical such as mercuric acetate, it will remain of the same composition for an indefinite period of time in the laboratory, no matter how much air we may draw through it, if we take care that no living organism is introduced with the air. If, however, the sewage is allowed to stand unsterilized upon the laboratory table in a considerable volume, or is allowed to pursue its way through the sewers for a number of hours, we find many and complex changes occurring in its organic constituents, owing to the mechanical, chemical and bacterial forces acting upon it. These changes are practically the breaking up of the organic matter into simpler forms, and are the initial step in the process by which it is finally changed to inorganic matter, or is set free as nitrogen, hydrogen and carbon gases. The change, as carried on in fresh sewage containing free oxygen, is as follows:

The carbon, under bacterial influences and in the presence of free oxygen, is oxidized, carbonic acid being formed; the nitrogen and hydrogen unite to form ammonia, and this unites with the carbon dioxide to form ammonium carbonate and probably other nitrogen com-

pounds, which we detect in our analysis as free ammonia; thus, until the dissolved oxygen is exhausted, the free ammonia increases, while the insoluble organic matter decreases. For example, a bottle of sewage, collected from the principal sewer at Lawrence and allowed to stand in the laboratory for twenty-four hours, showed the exhaustion of the dissolved oxygen in a period of about ten hours, although at the time of gathering the sample the sewage contained oxygen to an amount equal to 60 per cent. of saturation. At the time the oxygen had disappeared, the free ammonia had increased 110 per cent. and the organic nitrogen, as shown by the Kjeldahl method, had decreased 50 per cent. After a period of eight days, the free ammonia remained the same, but the organic nitrogen had further decreased by about 30 per cent. During this period also the oxygen consumed, which measures with some degree of accuracy the carbonaceous matters in the sewage, had decreased 50 per cent. During this period of eight days, the bacteria in the sewage had varied from 1,000,000 to 20,000,000 colonies per cubic centimeter.

Sewage, when its free oxygen has become exhausted and its free ammonia increased to the maximum possible by the exhaustion of its oxygen in the changes I have described, we have at Lawrence for a number of years termed stale sewage. It is sewage in this condition that we now and for the last five or six years have obtained at the Experiment Station at Lawrence, after the sewage from the sewer has passed slowly through some 4,000 feet of small pipe to reach the Station. This is also the condition in which sewage reaches many, if not most, of our Massachusetts disposal areas.

That the organic matter in suspension in sewage is the chief source of difficulty to be met and overcome in purification by intermittent filtration, was early made clear by our work at Lawrence, and all our investigations upon rapid methods of purification have dealt with processes of getting rid of in some manner, destroying, or breaking up into simpler forms, this organic matter in suspension. In a discussion that I made, on the composition of sewage and the permanency of filters, in the report of the Board for 1895, I stated that, if sewage is stale when reaching the filtration area, the organic matter in suspension is finely divided on account of the mechanical, chemical and bacterial forces which have acted upon the sewage, and a much larger percentage of the matter in suspension will readily pass into the open spaces of the filtering material than will be the case with the fresh sewage with its organic matter less finely divided; thus preventing clogging the filter's surface. I also stated in this report that the organic matter in stale sewage has been worked over to such an extent by the bacteria that, not only has the sewage lost a certain proportion of its organic

contents, but the remainder is of a nature more easily attacked by the oxidizing bacteria in the filter than organic matter in a fresher sewage.

These statements and the investigations giving rise to them were made because it was evident that the experimental sand filters in operation at the Station, while receiving during that and the previous year a greater amount of organic matter than during any of the earlier years of operation, were producing better results than previously, and were not storing much, if any, of the organic matter applied. For instance, two of our sand filters, 1-200 of an acre in area, which had been in operation for some years receiving comparatively fresh sewage, had become clogged in 1893 because of the storage of crude organic matter near the surface of each filter, and this stored organic matter had had to be removed, together with several inches of the surface sand. These filters, however, in the next two years, when this discussion was given in the report, and even up to the present time, have not become at all clogged, although more organic matter has been applied to them than during the years previous to the clogging in 1893; and 90 per cent. of the unoxidized organic matter in the sewage applied has been changed to the inorganic form and appeared as nitrates in the effluent, and much of the remainder has been lost into the air.

To further illustrate the better work of a filter receiving stale sewage, and to be sure that our conclusion, in regard to the operation of the filters just mentioned, was correct, two filters of like material and of the same depth were put in operation in 1896, one of which received the stale sewage pumped at the Station, and the other fresh sewage collected daily from a manhole in the sewer. The total nitrogen in the fresh sewage was 4.35 parts, and in the stale sewage 4.23 parts per 100,000. Only 27 per cent. of the nitrogen in the stale sewage was organic nitrogen, however, the rest being in the form of free ammonia; while 60 per cent. of the nitrogen in the fresh sewage was in the organic form, the remainder, or 40 per cent., being in the form of free ammonia. As we expected, the filter receiving the stale sewage took that applied without difficulty, stored 55 per cent. less nitrogen during its period of operation than the filter receiving the fresh sewage, and produced a somewhat purer effluent.

All our studies up to and practically through the year 1896 then, had been made with the classes of sewage which I have called fresh and stale sewage. When in sewage the oxygen is exhausted, bacterial life continues active and changes in the organic matter proceed, which continue and complete, if time enough is given, the breaking up of the organic matter into simpler forms; but as oxygen is not present, the action by which the matter is still further changed is a putrefying one, and the sewage becomes very ill-smelling, on account of the generation

and escape of hydrogen compounds of carbon, sulphur and phosphorus. Nitrogen is also set free in this putrefying process. The result of all these changes is to decrease not only the insoluble matters in the sewage, but to cause an actual decrease of the nitrogen present. Sewage, when in this state, is now known by the English term of septic sewage. There is no doubt that, to Donald Cameron, of Exeter, England, belongs all the credit due of first putting into actual practice, as a part of a sewage purification system, the intentional putrefaction of sewage by means of the so-called septic tank, as a sludge destroyer and preliminary aid to the purification and oxidation of sewage upon filters. I think the credit belongs to him, although many years before the installation of the septic tank at Exeter a similar tank, as recently pointed out by Dr. Rideal, known as the automatic scavenger, had been in use in France, and its actions and results studied and described. Besides this, certainly many thousand people had noted the liquefaction of solid matter occurring in a cesspool.

Since the introduction of the septic tank at Exeter, England, discussions and investigations upon the utility of it and the most favorable condition in which sewage can be applied to filters, have been extensive and most interesting. It was formerly supposed that the more quickly the oxidizing actions in a filter could be brought to play upon sewage, the more easy the purification. This we had disproved by the Lawrence experiments with stale sewage, and many things have been made more or less clear as to why certain filters failed where others succeeded.

It seems probable at the present time, from both our own and the English experiments, that any feature of a sewage purification system, that will encourage the growth of anaerobic bacteria and prolong the putrefaction of the sewage to a certain point at least, aids in the final treatment of it upon filters. For an example of not carrying the anaerobic actions far enough before beginning oxidation, the following can be cited:

At Lawrence for a number of years beginning in 1892, experiments were conducted where sewage was passed at a rate of approximately half a million gallons per acre daily through filters of gravel stones, and currents of air were blown through these filters. The experiments were carefully conducted and we know that, while in some these filters perfect aeration was not obtained, in others it was obtained, and immense volumes of air, as compared with the volumes of sewage applied, were forced through every part of these filters. As a result, fair purification was obtained, but the best ærated filters became so clogged with organic matter from time to time that, in order to continue their operation, all the filtering material had to be removed and washed,

and actual determinations of the amount of organic matter in this wash water showed that a very large percentage of that applied was stored in the filters. Since then we have operated filters at higher rates and for much longer periods without clogging. These more recent filters, however, have not had air forced through them, but the sewage has been applied in such a way that a certain volume of air is introduced with it into the filters. The reason for these two different results I consider at the present time to be due to the fact that a superabundance of air was applied in the ærated filters, with a consequent entire dependence upon oxidation of the organic matter, and we were practically preventing anærobic actions. Even when resting these filters at times of clogging, we drew air through them, still depending on the slow oxidizing actions; while recent experiments have demonstrated that we could have more quickly removed the stored organic matter if we had kept the filters full of sewage for several days, then allowed it to run to waste and then kept them filled again for several days more, depending upon liquefaction of this organic matter insead of oxidation, or at least before oxidation.

For two years now we have, amongst other things, been diligently studying the production and purification of septic sewage. At the Experiment Station we have a small septic tank through which sewage is passed daily and now, after twenty months' use, the amount of accumulated sludge is very small, although the effluent from this tank contains about 50 per cent. less organic nitrogen and carbon than the sewage entering it. The number of bacteria present in the tank effluent, moreover, is only about 15 per cent. of the number in the sewage as it enters the tank, as determined by ordinary plate cultures. The bacteria living while the sewage is passing through the tank and appearing in its effluent are, as we have determined, almost all faculative bacteria—that is, those capable of living either with or without the presence of oxygen. The effluent of the tank is always of an exceedingly offensive odor, generally darker colored than the sewage that enters it, but always clearer than the regular Station sewage. Large volumes of gas are evolved, this gas being largely methane, nitrogen and hydrogen.

The sewage entering the Lawrence septic tank is stale sewage, and this in a large measure accounts for the non-accumulation of sludge. The septic tank at Exeter, England, after twenty-six months' use, had 35 inches in depth of deposit and 2 inches of solid scum upon the top of the sewage; that is, 37 inches of the total depth of 88 inches, or 42 per cent. of the tank, was filled with the accumulated organic and mineral matter. With a fresher sewage than the Exeter sewage, I believe the accumulation of sludge might be more rapid.

Various toxins are also produced, I believe, by the bacterial action in the tank. As an experiment that perhaps shows this, we filled some months ago two glass tubes about five feet in length and two inches in diameter with very strong sewage sludge, and allowed the tubes to stand for the actions to occur which should result in the change of the suspended matters into soluble forms; one of these tubes being open to the air, and the other sealed. For a few days, gases were generated in the sludge at the bottom of the tubes, and more or less movement of the sludge took place. Shortly, however, the actions almost ceased and samples taken for bacterial analysis showed apparently an almost entire absence of bacteria in the sewage. A few developed upon our culture plates, but of course forms may have been present which would only grow on plates from which air was entirely excluded. That this was probably true was shown by the fact that, after a period of stagnation, gases were again generated, the sludge gradually becoming disintegrated, and at the end of a year fully 50 per cent. of the large amount of organic matter in suspension in the sewage originally in these tubes had passed into solution. It is possible also that enzymes may play a part in this phenomena.

That various toxins, or at least gases inimical to the life of oxidizing and nitrifying bacteria, are formed in the sewage while in the septic tank is, I think, conclusively proven also by the action of an intermittent sand filter which has been in operation at the Station for a period of about twenty months. This filter contains sand of a very favorable size for the purification of sewage by intermittent filtration. It was put into operation, receiving septic sewage at the rate of 100,000 gallons per acre daily; at the end of seven months, the rate was doubled; and later it was placed at 320,000 gallons per acre daily. At any or all of these rates of operation, the filter has taken this septic sewage without difficulty—that is, it has disappeared from its surface almost immediately, carrying with it into the filter the gases generated in the septic tank. Nitrification was very slow in starting in the filter and, although finally it became more or less active, the effluent has always been turbid, generally ill-smelling and containing little or no free oxygen. But to another filter of exactly the same construction, the septic sewage has been added at exactly the same rate, but before reaching the filter, it has been aerated by passing through a sprinkler to the surface, and the effluent of this filter has always been well purified, clear, practically without odor, and with a large percentage of free oxygen. A result similar to this second one has been obtained with a filter of sand, so fine that the sewage lingers upon the surface of it long enough to be exposed to the air and somewhat aerated before it enters the pores of the filter.

I have stated that the continuance of the anaerobic actions up to a certain point are a help in the purification of sewage. The reason why I believe that there may be a point beyond which it is unwise to carry this process is that, at one of the filtration areas of the State, we now and for the past six months have had in operation an experimental septic tank of about 10,000 gallons capacity. It is a new sewerage system and the sewage amounts to only about 70,000 gallons daily, and comes to the purification area so slowly through two miles of main pipe that it is practically septic sewage when reaching the area, having as an average 8.00 parts free ammonia and 1.29 parts albuminoid ammonia. This sewage is easily purified but, after passing through our septic tank, it is difficult to purify; in fact, after six months' application of this sewage to a well constructed bacterial filter of coke, we have not succeeded in starting nitrification.

With the so-called bacterial filters, better qualitative and quantitative results have been obtained when applying septic sewage at the Station than when applying a fresher sewage, and these filters operate month after month without diminishing in capacity more than 12 or 15 per cent., and this diminution occurs early in their period of operation. These bacterial filters, as many of you no doubt know, are constructed of material such as coke, cinders, etc., of so coarse a nature that sewage passes down through them in a few minutes,or at most a few hours, instead of passing at most only a few inches below the surface in the course of 24 hours, as is the case with the ordinary intermittent sand filter; the advantage of them being that the entire depth of the filter—that is, its entire capacity—can be used each day or even several times each day, the sewage being applied generally in doses some minutes or hours apart, and the outlet of the filter being closed during the period of flooding. The fact that these bacterial filters are constructed of coarse material prevents the formation of a scum of organic matter on the surface of the filter, as sometimes occurs with a filter of finer material, and which results in excluding air and preventing sewage from passing below the surface. With the cinder and coke that we have used, the open space of the filter approximates 55 per cent. of the total volume, whereas, the ordinary intermittent sand filter has about 40 per cent. of open space. In the filter of coarse material, moreover, owing to the fact that a much smaller number of particles is necessary to fill a given volume, each division of the open space is much larger than these divisions when innumerable small particles like sand grains form the body of the filter.

In stating the rates of operation of bacterial filters, I have followed the usual rule of calculating the rates by the surface area to which a given volume of sewage is applied. This is perhaps not the best

method, as the rate of a bacterial filter really increases with the depth of the filter, and a filter two feet in depth, while receiving two-thirds the volume of sewage applied to one of the same character and of the same area but three feet in depth, is being operated at an equal rate with the latter, when the actual volume of filtering material is taken into consideration.

Of course, in these filters very large rates can be maintained when compared with the rate of operation of the ordinary intermittent sand filter, but the purity of the effluents is much less, and these effluents are generally intended to receive further treatment upon finer filters. At the present time we are applying the effluent of a bacterial filter, which is operated at the rate of 550,000 gallons per acre daily and removing 65 per cent. of the organic contents of the sewage, to an intermittent filter at the rate of 1,000,000 gallons per acre daily, without difficulty, and are obtaining a clear, colorless and odorless effluent, practically free from unoxidized organic matter. Another bacterial filter, which receives septic sewage, operates at a rate greater by 200,000 gallons per acre daily than the filter just mentioned, and produces a much better effluent.

I have described the operation of filters of coarse gravel, through which we forced large volumes of air, and stated my belief in regard to the cause of the practical failure of these filters. By failure, I mean the clogging occurring, which would, of course, have been a formidable difficulty and prohibition, in fact, to the operation of filters of this kind upon a large scale. During the past six months I have had in operation at the Station, however, a filter of even coarser material than was in the gravel filters described, this filtering material being broken stone. The filter is ten feet in depth and through it we have passed sewage at the rate of 2,000,000 gallons per acre daily—a rate greater than we have ever attempted before and four times as great as that of the gravel filters formerly in operation—and have obtained generally an entirely odorless, well nitrified effluent. Here we are depending again entirely upon the oxidizing action without preliminary septic treatment, for the sewage passes in a trickling stream through this filter, the surface of which is never covered, and hence air and sewage are in intimate contact throughout its entire depth. This is shown, not only by an examination of the filter, but by the fact that the effluent contains a very large percentage of dissolved oxygen. I think, however, that at the present time the surface of this filter is becoming slightly clogged from accumulated organic matter that oxidation will very slowly remove. For this reason, we have just started a parallel experiment of passing sewage which has been through the septic tank through a similar filter and at the same rate, trusting that the

anaerobic actions have been carried so far in the tank that all that is neeeded now for the complete and rapid destruction of the organic matter is the perfect oxidation which we obtain in this broken stone filter operated at this very high rate.

The septic tank method of freeing sewage from its sludge, while exceedingly important and worthy of study and applicable to many places, would, I fear, be found to be out of the question as an adjunct to the purification of the sewage of a large American city. A septic tank system applied to the sewage of the city of Baltimore, for instance, would be something stupendous, as recently pointed out by the English engineer who was engaged by the Baltimore Sewerage Commission to report to them upon recent English experiments upon sewage purification; although I believe a modification of the septic tank could be constructed, intended to treat only the matters in suspension in the sewage and settled out daily while passing through ordinary settling tanks, flushing this accumulated sludge when necessary into a septic tank. Probably it would be cheaper, as a preliminary treatment before sand filtration in many cases, to rid the sewage of the matter in suspension by passing it through strainers of coke or coal, operated at the rates of from 1,000,000 to 2,000,000 gallons per acre daily, such as we have had for several years in operation at Lawrence on a small scale, depending upon burning it with some of the coke or coal, rather than destroying it by hydrolysis. The effluent from these strainers can be purified at nearly as high rates upon sand filters or bacterial filters as the effluent from the septic tank. For example, for five years we have applied to a sand filter at Lawrence, at the rate of about 300,000 gallons per acre daily, sewage which has first been strained through coke, and have not removed any sand or accumulated organic matter from this intermittent filter. During the past year, through our strainer, we have passed sewage in volumes equal to 365,000,000 gallons on an acre, and have not removed any of the coke from the strainer. Certainly an oxidizing action takes place in this strainer, although the effluent from it contains no nitrates.

In conclusion it can be said that natural methods of sewage purification are being constantly improved and expensive and unsatisfactory methods, such as chemical precipitation, are being forced from the field.

REPORT OF THE COMMITTEE TO EXAMINE INTO THE EXISTING SANITARY MUNICIPAL ORGANIZATIONS OF THE COUNTRIES BELONGING TO THE ASSOCIATION, WITH A VIEW TO REPORT UPON THOSE MOST SUCCESSFUL IN PRACTICAL RESULTS.

By CHARLES V. CHAPIN, M. D., Chairman.

When this committee was first appointed there was one member each from the Dominion of Canada and the Republic of Mexico and three from the United States. The chairman of the committee arranged for a division of labor by which the members from each country were to make a study of the sanitary institutions of their own land. Previous to the meeting, nothing had been heard from Mexico or Canada, so that this report deals only with the United States.

Dr. Mitchell was formerly chairman of this committee, but was obliged to be excused on his assumption of the duties of President of the Association; but previous to that he had prepared and sent out to various municipalities a circular letter of inquiry in which were asked a great number of questions concerning the sanitary organization of the cities to which it was sent. Answers were received from one hundred and twenty-one cities, and it is largely from the data thus furnished that the conclusions of this report have been drawn.

Your committee have found it a most difficult matter from a study of the various forms of sanitary organizations actually existing in the United States, to decide upon that form which gives the best results. Single health officers, Boards of Health, both ex-officio and appointive, of differing numbers and terms of service, and with a jurisdiction varying from a village to a state, are to be found, and examples of each one of them may be cited as producing most excellent results.

It would appear that there is something of far greater importance than the form of sanitary organization, and that is the character and attainment of the men who administer it. Unless the health officer or the members of the board of health are skilled and capable, it is useless to expect success in this department of municipal affairs. How to secure men of the character required, is a problem more difficult to solve than it is to decide upon a good scheme of organization.

First and foremost it is necessary for the people of the United States to learn that the sole qualifications for public office are honesty and ability. The notion that one man is as well fitted as another, and perhaps a little better for any public position, from that of the President of

the United States to that of village health officer is well nigh universal, and until it is eradicated, no branch of municipal government can be in the long run successful. When the public demands that fitness shall be a requisite for office, then will speedily follow civil service reform, just compensation, reasonable tenure of office and a proper training.

I. In regard to the political unit which should be made use of for sanitary organization, it may be said that it is almost universal for municipal governments, whether they be cities, boroughs or villages, to control their own sanitary affairs. The most conspicuous exception is the city of New Orleans which is under the sanitary control of the State Board of Health of Louisiana. There has been in some states some conflict of authority between municipal and county boards, and in some states the municipal boards are subordinate to the county boards, but as a rule the independence of the former is assured. It may therefore be concluded that:

Municipalities should have their own sanitary organization.

II. In districts outside of municipalities, the unit of political organization is not the same in different sections of the country. In New England, New York, New Jersey, and the states to the west which were largely settled from them, the township idea is supreme. The township is the unit of sanitary organization in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Illinois, Iowa, Michigan, Minnesota, Ohio and Wisconsin. In Pennsylvania, township boards of health have been tried, but have not been successful owing perhaps to the feeble development of the township in that state. Over the remaining portions of the country the county is of more importance than the township, and county health officials are found in Alabama, California, Colorado, Delaware, Florida, Idaho, Indiana, Kentucky, Kansas, Louisiana, Maryland, Mississippi, Montana, North Carolina, New Mexico, North Dakota, South Dakota, Texas, Tennessee, Utah, Washington, West Virginia. In Connecticut the county health officer is a recent creation. He is really a supervisor of the township officers, and it has been suggested that a congressional district would serve equally well as the limits of his jurisdiction. In Florida the state health officer has jurisdiction outside of municipalities except in two maritime counties.

Outside of municipalities the unit for sanitary organization should be the township or county according to the relative importance of these political divisions in the state in question.

III. A large portion of the states require the appointment by boards of health of a health officer, and when not required it is usually done.

It seems to be necessary that there should be a single executive officer who can attend to most of the duties to be performed by the sanitary department without calling a meeting of the board of health.

Every community which controls its sanitary affairs should be required by state law to have a health officer.

IV. The responsibility for the execution of sanitary laws is entrusted to boards of health or health officers and the former are much more common than the latter. Most of the states have general laws providing for local sanitary organization under special charters, though special charter making is not so common as in the past. Boards of health may be ex officio; that is, the county commissioners, the board of aldermen, town council, village trustees, or other municipal governing body may be the board of health. Such boards of health are found in the counties of Idaho, Montana, Colorado, Indiana, Kansas, Maryland, Tennessee and Washington; the townships of Massachusetts, Rhode Island, New York, Illinois, Iowa, Michigan, Minnesota, New Jersey, Ohio, Vermont, Wisconsin, and in the municipalities of Rhode Island, Colorado, Iowa, Louisiana, Michigan, Nebraska, North Dakota, Vermont and Washington. Also several cities under special charter provisions have ex officio boards of health, as Cincinnati, where the board of administration is the board of health; in Jersey City it is the board of police commissioners, and in Buffalo, Omaha, Kansas City, St. Paul, Portland, Oregon, and San Francisco, under the new charter, the boards of health consist entirely of city officials. In a number of states and cities one or more members of the board of health are such by virtue of their office. Thus in many cities the mayor is a member of the board of health and in some counties the attorney is a member.

Independent boards of health as distinguished from ex officio are found in counties in California, Delaware, Kentucky, Louisiana, Mississippi, North Carolina, North Dakota, South Dakota, Utah and West Virginia; and in townships in Maine and New Hampshire; and in cities under the general laws of Maine, Massachusetts, New York, New Jersey, Pennsylvania, Delaware, Louisiana, North Carolina, South Carolina, Mississippi, Kentucky, Indiana, Tennessee, Utah, Illinois, Wisconsin, Minnesota and California they are required, and in Rhode Island, Michigan, Colorado, Missouri and Arkansas they may be established.

A single health officer is found in the counties of Connecticut, Texas and Alabama; in townships, boroughs and cities of Connecticut; in Wisconsin, in cities of over 2,000 inhabitants and under special charter provisions in District of Columbia, in Brooklyn (until consolidation), in Denver, Baltimore and Chicago, Louisville, Cleveland, Pittsburgh, Allegheny and Toledo.

There are also not a few cities in which, although there is nominally a Board of Health the administration of the department is practically left to the health officer.

It will be seen that almost every imaginable form of sanitary organization may be found in the United States and instances will come to the mind of everyone familiar with the subject, of the successful working of each one of the various types. The committee has had great difficulty in arriving at any conclusion in regard to what form is the "most successful in practical results." We have not only considered the various forms of sanitary organization as we have been able to observe them ourselves, but we have consulted with a number of state officials of wide experience; but we are far from finding unanimity of opinion.

One of the greatest faults of American municipal government is lack of efficiency, and divided responsibility conduces to this. Most students of municipal affairs now recommend single headed departments and this principle is very generally recognized in most of the newer charters. If one man has the entire responsibility of the administration of sanitary affairs, he is more apt under the pressure of that responsibility to fit himself to perform his duties than if he were one of several members of a board and could share the opprobium for errors with his fellow members.

Such a single officer may receive advice and keep himself in touch with the representatives of his fellow-citizens by means of a sanitary committee of the town or municipal council. The single health officer should not have legislative power but the making of rules or ordinances should be vested in the proper legislative branch of the municipal government from which the sanitary committee should be appointed. If the membership of the legislative body is small as it may be in the case of town councils or village trustees there may be no need of a subcommittee, as the health officer can keep sufficiently in touch with the whole body of trustees or council. In a large proportion of cases when a council or board of trustees is ex officio the board of health, almost all the responsibility and work is thrown on the health officer and we have de facto a single headed department. In such cases your committee believe that the proper tendency should be to strengthen the power and responsibility of the health officer, rather than to weaken it by making him the agent of the independent board. We are therefore of the opinion that

A single health officer is the best form of sanitary executive. This we feel is certainly so in cities large enough to require such an officer to devote all his time to his duties. *While a single officer is to be preferred, we believe that in communities where a health officer's whole time is*

not required a small independent board of health with a health officer may give very satisfactory results.

The term of office of members of boards of health and especially of health officers should be long. This is also in accord with the views of the best students of political science and is the tendency of recent legislation. Four years is the term for health officers in Connecticut and Indiana and in several cities. In Buffalo the Health Commissioners' term is five years, and it is believed by the committee that this would not be too long a term for all health officers. Much may be said in favor of terms of office for good behavior, as is provided in the new charter for New York cities of the second class, but this is not acceptable to the majority of our citizens, and probably the best recommendation is to secure as long a term of office as the states and cities may be disposed to grant. Where there are independent boards of health, the term of the members should be at least three years, and it should always be arranged so that only a part of the board is changed at any one time. One of the most serious objections to an ex-officio board is that through the workings of practical politics the whole board is likely to be changed at once and perhaps annually. This evil is, however, partially counteracted if there is a health officer with a long term.

There is some difference of opinion as to whether the members of a board of health should be paid for their services. If the board is required to perform much executive work, the members should certainly receive some compensation. If, however, they are chiefly advisors and the health officer does all the real work, the proper course is not so plain. The board of health is then merely a committee of citizens to advise and sometimes direct. It is believed by many that such committees should receive no pay. It is far otherwise with the health officer. He should be paid for his services. It is a difficult matter to decide how much he should be paid. In small communities where the health officer does not have much to do, he should perhaps be paid by the day or visit as his other professional work is paid for.

When a health officer gives all or a considerable portion of his time to public health work, he should receive a salary. As the ability and professional training required of a health officer is equal to that required for the municipal attorney, his salary should be as great, but unfortunately it rarely is.

Many state officials believe that the local health officer should be appointed by the state, preferably by the state board of health; and state appointment does prevail in a few states. In Connecticut the county health officer is appointed by the supreme court, and he appoints the local health officer. In Vermont the local health officers are appointed by the state board of health. In Kentucky and Missis-

sippi the county boards are appointed by the state board of health and the state board of health has a voice in the appointment of local boards in West Virginia and the Dakotas. In Florida the state health officer has control over local affairs through his agents. The committee, however, believe that while there are advantages of central control to be secured by state appointment, the principle of local self government is too important to be disregarded, and that each community should appoint its own health officer. How he should be appointed can perhaps be best decided by each community, but most students of political science now advise that all appointments in cities be made by the mayor.

Of equal importance with the form of organization is the determination of the proper functions of the sanitary department.

A. LEGISLATIVE.

While there is and should be a good deal of statutory legislation on sanitary subjects, yet there are many matters which may well be left for counties, townships and cities to embody in local regutions. Authority to legislate on sanitary matters is usually conferred upon local governments by the legislature. The power thus given is often very great and expressed in general terms. It always should be so. Cities should always be given a broad power to make ordinances for "the preservation of health and the prevention and abatement of nuisances"; the enabling act should not go into particulars. This legislative power is usually conferred upon the board of health whether ex-officio or independent, but sometimes when there is an independent board, authority to legislate is vested in the municipal council. This is the case in Illinois. Where there is only a health officer and no board of health, such officer is rarely given legislative power, for this would not be in accord with our notions of government. The spirit of our institutions demands that law making should be in the hands of representative bodies, and sanitary legislation, which often in a marked degree interferes with the freedom of the individual, should be vested in the city council or other similar body. Furthermore recent decisions have indicated that legislation by boards of health is unconstitutional. Practically this is found to work well and there is perhaps less chance of regulations which will not be supported by public opinion than when rules are made by the board of health. The ordinances of Buffalo, Chicago and St. Louis are as useful as the board of health rules of New York, Philadelphia and Boston. The committee are therefore of the opinion that power to legislate on sanitary matters should be vested in the city council or corresponding representative branch of the local government. Two limitations of this legislative power have been noted by the committee, which may prove generally

useful. In Buffalo there can be no new sanitary ordinance adopted or old one repealed without the approval of the health commissioner. In Maine no regulation of a board of health is valid unless it has been submitted to a justice of the supreme court and received his approval.

B. Executive Duties.

1. *Appointments.* One of the most important of official duties is the apointment of subordinate officers and employes. The health officer should invariably have this power. He bears the responsibility for the work of his department and he alone should decide who his assistants shall be.

2. *The Management of Communicable Diseases,* including isolation, disinfection, medical inspection of schools, vaccination, etc., should be in the hands of the local health department. This is by far the most important work of the department and is the chief reason for its existence. As regards the laws controlling communicable disease, nearly every state has some statutes on the subject and many states have delegated power to make such rules to the state board of health, but in one state at least, Wisconsin, this has been declared unconstitutional. Perhaps it would be wiser to have statute law cover this subject as fully as possible, leaving as little as may be for local regulation. At present the duration of isolation is almost untouched by statute, but it might well be included, as there are good reasons why it should be uniform throughout the country.

3. *The Prevention and Abatement of Nuisances* should be in the hands of the health department. While this is a part of police duty which theoretically might be performed by the police, yet experience has shown that it is much better done by health officials, and the public has come to consider it one of the most important of sanitary functions. Under this heading may be included, the control of tenement houses and lodging houses. Many special statutes in regard to offensive trades are found in the different states and most of them give control to the local board of health, but in Maine and Rhode Island it is the town council which has this authority, and when there is merely a health officer and no board of health, it would be wiser to adopt this plan. The abatement of the smoke nuisance is left to the health department in New York, Chicago, Memphis, Milwaukee, Denver, Cleveland, Minneapolis, Yonkers and Kansas City, but in Cincinnati, Omaha, New Orleans, Indianapolis, Buffalo, St. Louis and Boston it is in some other department, such as that of inspection of buildings or of public works.

4. *Registration of Vital Statistics.* Most of the state laws provide for the records of births, marriages and deaths by town clerks or city clerks; but in the larger cities registration is very largely in the hands

of the health department. There are important reasons why sanitary officials should control the returns of deaths, and experience seems to show that all forms of vital records are better made by them than by city clerks. Outside of large cities, it is probably best that township clerks should be recording officers. Wherever there is business enough for the health department to keep a clerk and maintain office hours, it will be found best for the health department to administer the registration law.

5. *Plumbing Inspection.* As physicians and sanitary officials were the first to call attention to the evils of poor plumbing, it was but natural that the duty of enforcing laws to secure good plumbing should be laid upon these officers, and this is done in most cases; but the inspection of new plumbing is really a part of the general supervision of new buildings, and should be in that department whenever a community is large enough to have a department of building inspection. In smaller communities the inspection of plumbing should perhaps be in the health department, but if there is work enough for a special inspector he had better be an independent officer unless there is a building inspection department.

Experience has shown that the inspection of plumbing is performed by other officials just as well as it is by an inspector in the health department.

Among important cities in which plumbing inspection is not in the health department, may be mentioned New York, Boston, Cincinnati, District of Columbia, Milwaukee, Omaha, Kansas City, Providence, Memphis, Cambridge and Reading. Most of the plumbing codes are adopted in pursuance of special statutes authorizing this, but in many Massachusetts cities and in Maine and New Hampshire they are adopted under the general grant of power to legislate on sanitary affairs.

6. *Milk Inspection.* The adulteration of milk is forbidden by statute in most of the states and territories, and offenders are usually prosecuted under these state laws, though a few cities have local regulations; but as in the case of other perishable provisions, the enforcement of the law is usually in the hands of the local government. There are some exceptions to this, as in Iowa, where the state dairy commissioner appoints deputies to look after the milk in cities, and the state authorities of Massachusetts, New York, New Jersey, Pennsylvania, Ohio and some other states do more or less local inspection. Milk inspection is in the health department in many cities perhaps most, but the inspector is an independent officer in some, and in a few, the work is coupled with that of provision inspector.

The supervision of the milk supply involves something more than the detection of dilutions and preservatives. It is now believed that

we should insist upon clean milk and milk from healthy cows. None are so well fitted as health officers for determining the conditions needed to secure this. We therefore believe that the control of the milk supply should be in the hands of the local board of health.

7. *Control of Foods Other than Milk.* Nearly all the states have laws in regard to food adulteration, many of which are very strict. In many states the administration of these laws is in the hands of state authority, sometimes of the State Board of Health as in Massachusetts, New York, Maryland and New Hampshire, but more often of a food or dairy commission as in Wisconsin, Michigan, Colorado, Connecticut, Pennsylvania, Ohio, Oregon, New Jersey, Washington and Minnesota. Som times the food laws are enforced by the local board of health as in Boston, Cleveland, District of Columbia, Baltimore and San Francisco.

The inspection of perishable provisions, vegetables, fruit and meat is chiefly carried on by local officials, and many of the states have statutes authorizing it and providing penalties for the sale of decayed, diseased or unwholesome provisions. The inspection of animals before and immediately after slaughtering, is done partly by federal authority and partly by the local officers. It would appear to be better to have the enforcement of general adulteration laws left to state officials and the inspection of perishable foods to the local sanitary officers.

8. *Supervision of Water and Ice.* As the water sheds from which the public supplies are derived are almost never wholly within the limits of the community which makes use of them, it would be much the best plan for state authorities to have control of them. Unfortunately only a few states have, through their state board of health, established any efficient control, but it is very desirable that the legislatures should confer upon their state board of health very great authority in this matter.

9. *Hospitals for Communicable Diseases.* All cities of considerable size should have hospital facilities for the care of communicable diseases. Economy sometimes requires that such hospitals should be maintained in connection with general hospitals, but it is better that they should be entirely separate and under control of the health department.

10. *Management of General Hospitals and Medical Poor Relief.* In a few cities as San Francisco, Indianapolis, Memphis and St. Louis the general hospitals are in charge of the health department, and in these cities and some others, as District of Columbia, Denver, Cincinnati, Cleveland and Jersey City, Nashville, Newark and Charleston, outside medical assistance is given by the same department. There are excellent reasons why all municipal work requiring medical direction should

be in charge of the health department, but your committee hardly feel like recommending this as generally advisable.

11. *Bacteriological Laboratory.* It is not possible to carry on sanitary work with the best results without the assistance of a bacteriologist. For the management of diphtheria, typhoid and phthisis, such assistance is essential. In rural districts and small communities it is not feasible to maintain a laboratory, and for their benefit the state board of health should do so; but every city of any considerable size should have its own laboratory or certainly its own bacteriologist.

12. *Removal of Refuse.* The work of scavenging is one of the most important functions of municipal government. Garbage, ashes and dry refuse, street sweepings and night soil, all require different methods of treatment. Nearly all cities provide for the municipal collection and disposal of garbage, and the majority impose this work upon the health department, and it is done sometimes by contract and sometimes by city employes.

A majority of cities collect ashes and dry refuse, but the number is not as great as that which collects garbage. In probably less than half of them is this work done by the health department.

The removal of night soil is almost always done by private individuals, usually licensed by the health department.

Street cleaning is almost never done by the health department though it is almost always done by the municipality.

All departments of scavenging are usually regulated by the health department.

Your committee believe that all forms of scavenging had best be done by the municipality either by contract or otherwise. As scavenging is a business operation, it is best entrusted to the department of the city government which has charge of other public works. The work of the health department had best be limited as far as possible to professional and scientific work. Professional and business ability are not often found in the same person, while the department of public works ought to be if it is not, entrusted to men of marked business ability. The health officer will be freer to devote his attention to the control of communicable disease, if he is not burdened with the details of garbage and ashes collection, and his department will be less likely to be entangled in politics. Patronage is dangerous for the health department.

The committee have endeavored to outline a scheme for sanitary organization which would be adapted to the needs of the greater portion of this country. It is not, however, to be expected that it must be adhered to in all places and in all particulars. Flexibility is a characteristic of Anglo-Saxon institutions and local and temporary needs

often require considerable modification of ideal forms of government. Indeed the committee has not attempted to recommend an ideal form of sanitary organization, but rather a practical form which for the present and near future would seem most likely to give the best results.

Respectfully submitted,

CHARLES V. CHAPIN,
WM. C. WOODWARD.

BRIEF REPORT ON THE ORGANIZATION OF THE BOARDS OF HEALTH IN THE MEXICAN REPUBLIC.

There are eleven Boards of Health in the Republic and one Sanitary Inspector. The eleven boards are in the following States:

Board of Health for the State of Mexico—Toluca.
Board of Health for the State of Chihuahua—Chihuahua.
Board of Health for the State of Jalisco—Guadalajara.
Board of Health for the State of Michoacan—Morelia.
Board of Health for the State of Morelos—Cuernavaca.
Board of Health for the State of Queretaro—Queretaro.
Board of Health for the State of Oaxaca—Oaxaca.
Board of Health for the State of Yucatán—Merida.
Board of Health for the State of Nuevo Leon—Monterey.
Board of Health for the State of Zacatecas—Zacatecas.
Sanitary Inspection for the State of San Luis Potosi—San Luis Potosi.

The Boards of Health are appointed by the Governors of the respective States.

As a general rule the appointments are made in view of the ability of the persons, and seldom by political intrigue or influence. These appointments are for an indefinite time.

The boards have the full support of the authorities, but up to the present, the ignorant masses do not give them the importance that they deserve.

They are controlled by laws and regulations, which are very similar to those of the Federal District.

The Supreme Board of Health of the Federal District exercises local powers in that district and federal powers in the ports and frontiers. The other boards throughout the Republic only exercise authority in their respective States, with the exception of the ports and frontiers, but they have authority there in matters of a strictly local character. There is also in the Town Councils throughout the Republic a Medical Officer who looks after all questions of public health.

The Boards of Health of the Republic have control of everything except the cleaning of the public sewers and the drainage of swampy ground, as these matters pertain to the Town Councils.

A great deal of difficulty is encountered in the execution of sanitary measures in the States on account of the ignorance of the masses, and the routine methods of the officials.

The best organized board, after that of the Federal District, is that of the State of Mexico. In this State there is a hospital for the isolation of persons suffering from contagious diseases.

The physicians throughout the Republic are under the obligation of reporting all cases of contagious disease, and measures are taken for their isolation and disinfection.

This service is carried out with difficulty in most of the States, through the want of the necessary establishments and plant.

Vaccination is very much neglected in the greater part of the States, and only in the principal centres of population is it carried out with a little strictness.

The sanitary authority of the State has no efficient means for overlooking the construction of public buildings or schools.

With respect to the cemeteries, burials and dead bodies, the sanitary provisions are similar to those of the Federal District. There are special officers in the county seats for registering births, marriages and deaths. The registry of births is much neglected.

The transportation and disposal of garbage and town refuse is in a most lamentable condition throughout the whole of the Republic and is under the charge of the corporations.

As the manufacturing industry is very limited in the Republic, no special laws have as yet been enacted, excepting in the Federal District, for the control of dangerous, unhealthy or inconvenient industries.

Bacteriological laboratories for the examination and diagnosis of pathological substances have as yet only been opened in the Federal District and in the States of Jalisco, Mexico, Chihuahua and Yucatan.

The results obtained by the establishment of Boards of Health in different States of the Republic, are now making themselves felt, especially in the States of Mexico, San Luis Potosi and Yucatan. In the first of these States, they have obtained the disappearance of small-pox and typhoid which formerly were very common; in the second they have obtained the same results with regard to typhus, besides a general decrease of infectious disease, while in the third they have greatly diminished the endemia of leprosy and yellow fever.

D. ORVANAÑOS.

Mexico, August 29, 1898.

RURAL SANITATION IN ENGLAND.

By WILLIAM H. ALLEN, Philadelphia, Pa.

Throughout the civilized world the State has recognized its obligation to protect the public health. To that end a vast amount of sanitary legislation has been enacted during the past fifty years. The State recognizes but two limits to the exercise of its authority in sanitary matters—the outer limit, where private health ceases to be of vital importance to the State; the inner limit, where governmental control ceases to be practicable. The line of demarkation between private and public health is drawn by medical science and naturally shifts and widens as information increases and as conditions of society change. This line of demarkation is always greatly in advance of the limits of practicability, as the inclusiveness of a principle is always greater than its practical application. New discoveries of science, however, as well as changes in social structure, frequently cause the impracticable to become practicable. The coming of a new Jenner would make *administrative* control of tuberculosis in man as practicable as the test for tuberculosis in animals. The necessity of utilizing river water for drinking purposes has proven the feasibility of protecting rivers even at the cost of introducing entirely new and revolutionary administrative machinery, such as the metropolitan boards of Massachusetts. Just how the State, at any particular time, should crystallize the teaching of science in legislative enactment depends entirely upon the social conditions of the period. Sanitary codes which do not fit the conditions of the society to which they apply are as much a blunder as the choice of laughing gas for nervous prostration or the tuberculin test for measles. Dynamic societies demand progressive sanitary legislation; for changes in condition we should expect changes in administration; to account for differences in legislation and administration there should be corresponding differences in conditions.

An examination of statutes, whether in Russia, India or the United States will show the large city is a generation in advance of the smaller city and a century in advance of the town and rural areas (in knowledge and application of sanitary measures.) Nor is this strange. Good legislation like good generalship strikes first and hardest at the strongest enemy. The cities were ports—ports admitted plagues—the State fortified itself against infection from abroad by imposing certain obligations upon the port cities. Infectious diseases were most virulent where they had most to feed upon—the cities had more dark alleys,

filthy gutters, congested areas and other disease breeding conditions. The State saw the port city protected against itself. But the increasing industrial interdependence of metropolis and provincial city soon made every city a port. Wherever there was congestion of population there was a facility for communicating disease—the State imposed obligations upon the smaller urban communities and instituted inspections and restrictions upon personal liberty. The rural district was overlooked, for it was thought to be of comparative insignificance to the State, whether an isolated case of fever broke out in some small hamlet or farmhouse.

But the industrial revolutions of the past half century have brought the country to the town. Dairyman and butcher, church and fair, river and canal, railroad and postoffice keep country and town in daily communication. A dairyman fifty miles from Minneapolis may transmit scarlet fever to a thousand school children in that city. One case of typhoid on a farm 125 miles from Philadelphia has rendered the water of the Schuylkill unfit for drinking purposes. By sad experience we know that isolation is a thing of the past. Barn-yard health stands in vital organic relation to the health of the avenue. If the state is to benefit from sanitary administration in large cities, should it not protect the city against infection from the country as well as from the sea? Should it not make possible the protection of water supplies, of milk and provisions? Industrial changes have brought the city into constant intercourse with the country; should the State recognize this change by fitting its sanitary legislation to the changed conditions? If bacteriological experiments and the history of epidemics show that even under earlier conditions the health of the rural district was of vital importance to the State, should not the State admit that past legislation never fitted conditions and provide new organization for the semi-isolated sections? Admitting its desirability, is systematic and constant rural sanitary administration practicable?

Such are questions which sanitarians and legislators must answer. English sanitarians years since proved that England suffered acutely from disregard of health laws in rural districts. Being a small country with a large population and direct facilities for communication—having undergone industrial revolutions which rapidly transformed rural into urban communities—she saw that isolation was no longer possible. Of vital interest to the whole State was the sanitary condition of every house whence man or merchandise found exit to the public highway. Rural sanitation had become a matter of State concern. To discharge her responsibilities county and district were given new duties and new powers. A system was established which has reached its highest development in the County of Lancashire and the rural district of West Lancashire.

The former, a county of one hundred and twelve urban districts and twenty-two rural districts, shares with the central government the expense of a Medical Officer of Health, who is paid $4,500 a year to give his entire time to the study of sanitary conditions in the county. This officer has for twenty-five years been connected with the administration of public health, is a physician of exceptional training and high standing in his profession. The essential fact here is that there is a medical expert giving his time and talent to the discovery, analysis and remedy of local conditions which endanger public health. The public authority cannot possibly—any more than our State boards of health—study in detail local conditions. Consequently they cannot recommend or enforce discriminating preventive measures. The County Medical Officer does intensive work. He *knows* and *understands* the needs of each district. He is eyes and brain for the State. He is the State judging and acting locally. Is there need for such attention to provincial conditions in the United States?

But perhaps his most important work is that of photographer. His annual report pictures the sanitary condition of his county, reflecting the defects and achievements. Here are set side by side the results of a year's administration in the various districts. Progress in district A is contrasted with laxity in district B. The returns are made a subject for neighborhood comment. A medical officer in one district dislikes to feel that his colleagues through the county have his own statement to the effect that work in his district has been unsatisfactory. Publicity is a great stimulant. If reports are not printed, the Medical Officer mentions the senders of illegible manuscripts. Reports must show progress, or invidious comparisons are made and local pride is wounded. Failure to send annual reports means loss of half the local officers' salaries—may even mean complaint to the Local Government Board. Much needed reforms must be instituted and aggravated evils abolished; insanitary areas condemned; water and food supplies protected; drains provided, etc., or the county will make representations to the central authority in London and a State inspector will come to investigate local administration. Such a rebuke no self-respecting English council wishes to bring upon its district. Since, ten years ago, the county began to publish an annual criticism of the administration in the constituent districts, about one hundred districts have decided to print their reports. Death rates have fallen considerably, in spite of increasing populations and the extension of industrial establishments.

DEATH RATES IN RURAL DISTRICTS.

	General		Zymotic	
	1889	1897	1889	1897
Blackburn	23.5	15.9	3.00	1.94
Bolton	18.1	14.9	2.60	1.99
Chorley	18.4	16.7	1.90	1.38
Preston	17.3	14.3	1.70	1.51
Wigan	15.6	11.6	....	....

General vigilance has been stimulated; attention to sanitary needs has increased; standards of cleanliness have advanced; civic consciousness has been awakened; the community responds with more generous support of sanitary authorities and higher salaries to the officials who inspect, advise, condemn, prosecute.

So much for the County Medical Officer as photographer and adviser. He is directly concerned in the execution of the Isolation Hospitals Act of 1893, which empowers county councils to order the erection of fever hospitals for districts, upon the declaration of county medical officers that hospital accommodation is necessary. Ten years ago Lancashire had but eight urban hospitals and one rural. To-day there are twenty-three urban and four rural. According to the report of 1897, thirty-seven districts were arranging for hospital service. If skeptical of progress in "arrangment" the council exhorts to "action."

In 1897 over twenty per cent. of the cases in the county were treated in hospitals. The case mortality in hospitals was 2.5 per cent against 6.6 per cent. at home. In 1895 and 1896 the percentages in the hospital were 3.7 and 3.3, compared with home rates of 6.4 and 5.1. These figures represent a saving to the community far greater than the cost of maintaining hospital service and the entire sanitary organization. Adding to this saving that represented by the diminution in the number of cases, the county officer finds most conclusive arguments for the extension of hospital privileges to smaller communities. English experience has justified State provision against infection in less settled areas. Are there differences in conditions which justify the absence of hospital facilities in our rural districts? If they are needed, what legislation is necessary to introduce them?

The county sanitary authority is for most purposes statistician, analytical critic and publisher, rather than administrator, which presupposes throughout the county numerous executive bodies. These are the rural and urban district councils which execute the laws through their medical officers of health and sanitary inspectors. Of particular interest to us is the nature of the administration in rural districts. To that end, I want to cite as example, the rural district of West Lancashire, about fifteen miles northwest from Liverpool. This district comprises seventeen townships of 68,614 acres, with a population of 27,514 living in 5,260 houses. While there are several villages and hamlets, it is essentially a rural community. Farm buildings are isolated, pig sty and barnyard are constant elements—just such an agricultural area as we may find in any of the United States, like Mower County in Minnesota or Lycoming County in Pennsylvania. This district employs a medical officer of health at $1,500, two sanitary inspectors, and a surveyor-engineer who passes on structural plans. Half the salaries are paid by the county. The town clerk is the council's representative on the staff and takes a lively interest in sanitary matters.

The personnel of the staff is the first point of interest. They all earned their appointments by competitive examination. The senior inspector has been in the service for nineteen years and expects to devote another quarter century to the came cause. His colleagues tell for him that for nineteen years he has walked through his district counseling, educating, warning, threatening, prosecuting, and "has never lost a case." The junior inspector was chosen from two dozen applicants, most of whom, like himself, possesses diplomas from the Sanitary Institute, certifying that they are qualified by study and practice to administer public health regulations. The Medical Officer of Health is a young physician of good standing, who secured the degree of M. D. from Edinburgh. He has supplemented his medical course by securing the degree of Doctor of Public Health.

The second thing to note is the annual report which these officers publish. A great amount of definite local information is organized and presented. Every citizen of the district can find there a statement of the work done by the sanitary staff. He sees fully explained just what is expected of him as occupier or owner of premises. He learns with what severity the magistrates have punished infringement of the council's regulations; he reads how much it costs to adulterate milk, to continue the use of a condemned water supply, or to neglect to notify a case of typhoid or diphtheria. Would our rural sections profit by having local conditions thus presented to them? Would it arouse civic interest in sanitary matters? Would it facilitate administration?

Third and of most importance is the nature of the daily work which the above mentioned report summarizes. It is one thing to pass regulations, it is something different to enforce them. Until I had seen an inspector at work, I was rather skeptical as to the practicability of efficient administration in rural sections. We had not visited many houses, however, until it became evident that the Chief Inspector stood for English law, that his frown and censure were ominous; that behind him the offender saw very clearly a council and magistrates ready to act and to compel action. Furthermore, the alterations completed and in progress along the country roads showed that "the sanitary authority had been there." I was astonished to see how important a social revolution had taken place in ideas of "self government" and "individual freedom," as manifested in the powers which the sanitary authority was exercising, with the apparent hearty co-operation of the individual whose "freedom" was affected. Where premises were inspected for the first time, a form was filled out covering every point from the age and sex of the servants to the cubic capacity of the cowshed. Where premises were inspected for the purpose of comparing with their conditions at some previous inspection, particular regard was paid to *drainage, water supply and sanitary condition of dwellings.*

DRAINAGE. In three townships only were there sewage systems. Aughton, for example, with 700 houses on 4,600 acres, had a sewage plant with filtration beds which furnished fertilization for our crops of grass. About the only cost of this modest plant was the laying of the drains and the price of ten acres of land. Once established, the works were kept in order by an unskilled laborer who was responsible for the drains. Tommy does not cost much—his is not skilled labor—he was hired in fact, as he says, "'cose I didn't know nawthin' abaut it." The Medical Officer of Health is responsible to the river board for a pure effluent. Elsewhere, drainage was private and dependent upon house drains, yard pavement, privy ashpit, cesspool and the existence of drains and catch basins for manure piles and pig-pens. At one large farm two miles from a railroad, alterations were in progress which illustrated nearly all the various exactions of the sanitary authority. In the absence of a cistern, the landlord was compelled to drain the roof-water into a culvert five rods from the house. The approach to the house was to be paved to prevent its becoming a cesspool. About forty feet from the house was an ashpit and privy, under the same roof as a pig-pen. In the garden, fifty feet from the house, was a cesspool. Out in the road was a manure pile which had been ordered removed—future accumulations to be permitted when proper drains had been put in. In this particular house township water was supplied.

The principal fact to be noted with regard to these improvements is, that they were being put in *upon order from the sanitary authority, according to its regulations, behind which stood the authority of the English Parliament.* The engineer had previously approved the plans, the inspector was seeing that the plans were followed to the letter. Privy and ashpit were combined, the floor asphalted "six inches above the level of the surface of the ground adjoining such privy * * * with a fall toward the door * * * of half an inch to the foot." The receptacle was likewise asphalted, three inches above the ground, with access so that the contents might be easily removed. Through ventilation was provided by openings above and below the doors, by a window and by a permanent aperture in the brick wall. The community has evidently been instructed in the æsthetic, sanitary and economic advantages of the liberal use of ashes, etc.

The adjoining pig-pen was also built according to regulation. The floor was flagged and drained into a catch basin. This case was duplicated a score of times, and I saw that in practice as in theory, a pig-pen, no matter how isolated, was considered a nuisance unless this provision for sanitary housing was made. The inspector is convinced that there is "no need for a pig to make a hog of himself."

The cesspool was of good brick work, properly rendered inside with cement and with a backing of at least nine inches of well puddled clay. Ventilation was provided; the pool was wide enough to make cleansing easy. The cover was an immense stone slab. As in the case of midden drains, ashpits and pig-pen, the farmer was taught the importance of preventing the waste of any valuable fertilizing materials. At another farm house, two cesspools were seen. One was condemned, not because it was not properly built, but because it was only forty feet from the house, while the regulations demand fifty. In front of a row of buildings in Aughton sewer pipes were being laid. The cesspools back of the houses were overflowing into a ditch. The owners—one of whom was the Chairman of the Sanitary Committee—were given the option of constructing a new cesspool for each house according to regulations, or at their own expense connecting with the public sewer some one hundred yards distant. Again and again we saw outbuildings which had been altered after construction because plans had not been followed—an apparent damage to individualism in country carpentering.

Water Supply. In Halsall, a township with 250 houses on 7,000 acres, was a township water supply, forced upon the township by the district council acting upon the advice of the Medical Officer. A certain house was pointed out where township water was recently introduced to take the place of a "hole in the ground" in the woods about

five hundred yards from the house. The pipes had been put into the new house before the roof was on. The owner was not even allowed to wait until the grain could be harvested from the field through which the pipes were to be laid. We saw the path of destruction and the unplastered house furnished with the best of water. A mile distant lived a man, whose landlord haid paid $75 for the privilege of contesting the district's right to enforce the water regulations. In another famous case, the owner of a foul well declared that his drinking water, foul as it was, "just suited his nature"—an opinion which he sustained by paying the cost of suit and fines under two separate charges for violating an ordinance and for obstructing the inspector in the discharge of his duty, plus the cost of introducing water pipes. Private wells were tested, for which purpose the inspector carries a large bottle in a leather case. In 1897 forty-three wells were condemned by the Medical Officer of Health. Nearly two-thirds of our population are supplied with drinking water from private wells. Does the State properly protect itself against carelessness in the selection and use of these wells?

Dwellings. The unfinished house above referred to was part of a general scheme for improvement ordered by the sanitary authority. Although a quarter of a mile from the public road the old house and the premises on which it stood were condemned along with the hole in the ground, whence drinking water was obtained, as unfit for human use. Plans for the new house had been submitted and approved—the builders had executed the plan. Through ventilation was provided and windows and rooms were constructed with a view to admitting air as well as light. Improved water supply, ashpit, cesspool, etc., were instituted.

This was but one of many cases where properties were by order of the sanitary authority either closed or in process of reconstruction. Privies were removed forty and fifty feet from wells; corrugated roofs were submitted for leaky thatches, overcrowding was remedied by raising roofs and increasing living space, or entire dwellings were relegated to the kindling pile. The owner is rarely the occupier—he has the choice of improving the property and holding the tenant, or losing tenant and income.

To Recapitulate. City, town and country are in constant communication. The State is vitally concerned in the protection of health in rural districts. England has undertaken to protect the whole State against neglect of health laws in rural communities as well as in cities. County councils and district councils are agents of the State in dealing with local conditions. The State contributes to their salaries. The County Medical Officer of Health is critic, statistician, photographer,

educator. In addition, upon his recommendation, urban and rural districts are compelled to provide for isolation of infectious cases. Case mortality has decreased to a marked degree and the number of cases has diminished with the virulence of the disease. Rural districts have regulations with special regard to ventilation and cubic content of dwellings and cowsheds, provision for drainage, scavenging, pure water supplies, etc. Medical officers of health, sanitary inspectors and engineers of recognized preparation execute the regulations. Councils and magistrates and communities support these officers. Whether conditions similar to those which prevail in England are duplicated in any other country is a question of fact. Are there insanitary conditions in our rural sections? Do these menace the health of the State? Has the existing sanitary authority sufficient powers? Has the central authority sufficient initiative or adequate powers to compel local activity? Questions such as these the American Public Health Association is best able to answer.

HISTORY OF VACCINATION.

By Dr. WILLIAM BAILEY,

Member State Board of Health, Louisville, Ky.

Mr. President—By your request I beg leave to present to the Association a brief history of the introduction of cowpox as a prophylactic measure against smallpox.

Variola had, for many centuries, proved itself to be one of the most fatal and dreadful scourges to which the human family was subject. It was no respector of persons, the king in his palace and the peasant in his hovel being alike its victim. Its fatality was not its only characteristic for its treacherousness and its power to maim and disfigure was almost equally to be dreaded. If time allowed it would be at this time interesting to consider the practice of inoculation that was in vogue the large part of the eighteenth century.

No doubt the practice had been in use in the far east for a long time. This subject is now of particular interest to us because we find the custom enabled those who at the close of the last century were endeavoring to prove cowpox antagonistic to smallpox, to prove their work.

No difficulty existed in testing the efficiency of vaccination as a preventive measure for the people often were clamoring for inoculation and hence this easy, ready and efficient means was at hand to test the value of the method. An interesting account of the introduction of the practice of inoculation into England is found in history.

It seems that the custom was observed and approved by Lady Mary Wortley Montague in 1717. Her husband was at this time the ambassador at the Ottoman court, and in a letter of this date to her friend, Miss Mary Chiswell, she says:

"I am well satisfied of the safety of the experiment since I intend to try it on my dear little son. I am patriot enough to take pains to bring this useful invention into fashion in England; and I should not fail to write to some of our doctors very particularly about it if I knew any one of them that I thought had virtue enough to destroy such a considerable branch of their revenue for the good of mankind. But that distemper is too beneficial to them not to expose to all their resentment the hardy wight that should undertake to put an end to it. Perhaps if I live to return, I may, however, have courage to war with them."

You will observe that this has almost the modern ring about it. Her son was perhaps the first English subject that received inoculation, which he did in March, 1717. No account is given to show that any-

thing was done until 1721. Soon it was approved by many of the profession and we find that it was a common practice for the remainder of the century.

Its history shows its beneficent influence and if nothing better had been discovered I have no doubt that under proper restrictions it would have been in common use to-day.

Objection to the method was based upon the fact that it was accompanied by some fatality and also the fact that each person inoculated might be the nucleus for the spread of the disease by contagion in the usual way.

Very properly now for these reasons inoculation in most countries is prevented by law.

If cowpox was not preventive I would at this time urge inoculation for it might be done with a minimum of danger by selection of the virus and the isolation of the subject during the course of the disease.

Many inoculators claimed to make the disease milder and hence less objectionable by preparatory treatment and by taking the virus at an early period in the history of the case from which it was derived. Sutton, Dimsdale and others so taught. Dimsdale was summoned to Russia in 1768 to inoculate the Empress. This submission on the part of royalty gave an impetus to the custom. Dimsdale is said to have been made a Baron of the Russian Empire, was appointed Councillor of State, Physician to her Imperial Majesty and was awarded the handsome fee of $50,000 and in addition was given an annuity of $2,500.

Evidently there was some appreciation of his services.

History seems to show pretty conclusively that during the last quarter of the eighteenth century there was a widespread belief among dairymen and dairymaids that those who contracted the disease of cowpox from milking cows, thereby infecting any abrasions or sores on their hands, were not subject to smallpox. No doubt exists in my mind that such opinion prevailed before the work of the immortal Edward Jenner was done in confirmation of it.

He is none the less to be honored on that account for he only seems to have been possessed of the courage of his convictions and pursued his observations and experiments until he practically made a demonstration. Often in the arts we find it is not the man who first conceives the idea who is the inventor, but the one who has the ability, the pluck, the genius, if you will, to take hold, to keep hold and never let go until he realizes the fruit of his labor, and he is given the honor. All honor then to the name of Jenner, for he never quit until the world acknowledged his claim.

I doubt if he was the first man who intentionally vaccinated with cowpox virus to render persons immune as against smallpox.

It seems credible to me that there is truth in the statement made that in the year 1774 one Benjamin Jesty vaccinated his wife and two sons directly from the cow and that the efficiency of his work was demonstrated by their refusing to contract smallpox by means of inoculation.

In proof of this fact we find that Mr. Jesty visited London in 1805 and that a dozen or more members of the Jennerian Society signed a statement that he had without precedent vaccinated his family thirty-one years before that time and that he justly deserved the gratitude of his country, etc.

It is stated that his tombstone bears record to the fact that he vaccinated his wife and sons in 1774.

No proof exists so far as I know that at this time Jenner had vaccinated anyone with cowpox, but his observations concerned those only who had contracted the disease from the cow in the act of milking her.

Jenner was early possessed of the idea that the origin of the cowpox was a disease of the horse known as grease in the heel. He claimed that men taking care of the horse so diseased with grease in the heel infected the cow and then the milkers were infected. He even urged that grease in the heel of the horse, pox in the cow and smallpox in man were most probably one and the same disease. Cowpox was now styled cow smallpox. He met with many obstacles in his work and no doubt one of less determination would have given up in despair.

Much work was to be done, for several of the lower animals besides the cow were subject to diseases somewhat similar to cowpox and the inoculation of persons with virus from these diseases showed phenomena similar to vaccinia, and hence advocates claimed that these likewise gave immunity to man from smallpox. No doubt many persons at this time received vaccination with virus that possessed no protective power and hence confusion was worse confounded. Those who opposed him brought forward many instances where those who had been vaccinated afterward contracted smallpox and he answered the objection by suggesting that they had not received immunity for the reason that they had received a spurious vaccination.

It is perhaps true this day as well that many have only a quasi-protection because they rely upon a spurious vaccination.

Many today estimate the success of the vaccination by the degree of soreness developed rather than by any characteristic of the specific eruption.

We ought not to wonder at the mistakes of that day when we remember the little knowledge possessed by even the most learned in regard to the science of either physiology or pathology, and still more when we remember that bacteriology was unknown.

There are germs and germs. What an advantage it would have been to Jenner to have been possessed of an inkling of mixed infection.

Many objections urged against him and his claim could be easily surmounted with the knowledge of the present day. Jenner seems, from history, to have been unsuccessful in his first efforts to make public his convictions and the results of his inquiry.

He submitted a paper to the Royal Society of London styled "An Inquiry Into the Natural History of a Disease Known in Gloucestershire by the Name of Cowpox."

This was not accepted for publication by the society, but was published by Jenner himself with additions in 1798.

Afterward other editions were published and by permission dedicated to his Majesty, the King.

Unquestionably history shows conclusively that vaccinia has been known to give immunity from smallpox.

I will not worry you with statistics that show so well the benefits that have come to the human family from the priceless boon for these are read and known of all men. I think this association should proclaim again and f om the house tops its faith in the protective power of vaccination against smallpox, for its enemies are organized and aggressive in their warfare against it. Allow me to say that I think it was unfortunate that Jenner claimed that vaccinia invariably and forever guaranteed immunity perfect in character.

It does not seem reasonable to expect that any acquired immunity shall be better or more lasting than that furnished by the disease. Nothing is gained by claiming too much. It is certainly proved that the degree of immunity may vary with time and circumstance. Since bacteriology has become a science more profound study is being made, particularly with the view of obtaining a virus that shall be pure.

If only a pure culture can be furnished then, by following strict aseptic precautions we can safely say that the disease vaccinia is not a danger to the life nor even a menace to the health of those receiving it. We will then have a measure for protection as perfect as it is possible to obtain. Allow me to suggest that immunity ought to be secured by repeating at intervals the vaccination until the system shows itself to be no longer subject to its influence; and again at intervals, if smallpox prevails, for fear that susceptibility may have been redeveloped.

THE ACCIDENTS OF VACCINATION.

By Dr. W. C. WOODWARD,

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Mankind is apt to estimate the magnitude of a thing or act according to its apparent size or importance, rather than to seek for some accurate method of measurement and comparison. Physicians form no exception to the rule. So when we consider hip-joint amputations, trephining, abdominal section, and other like matters, either in our practical work or in establishing and carrying out curricula for medical schools, the risks to the patient,and to the various interests of the physician, are so manifest that the subject receives due attention. Minor matters, however, do not stand on the same basis, and vaccination is ordinarily classed among them. It is, apparently, so trivial an operation that it is too often carelessly performed and seldom receives in our medical schools the consideration which it deserves. From the standpoint of public health, and indeed from the standpoint of individual well being, this should not be so. The major operations which receive so much consideration affect a much smaller number of persons than does vaccination. Such operations are performed by a select few, and involve no personal risk except to the patients. Vaccination all of us must do; and while it involves a risk to the patient it involves also, if improperly done, a danger to the community in that it may result in the individual contracting smallpox and infecting others. From an executive standpoint, too, it is important that no unnecessary injury accompany it. Those engaged in public health work know how much even a single sore arm increases the difficulty in inducing or requiring those familiar with the case to submit to vaccination, and to what extent the general vaccination of a community may be thus interfered with.

The term "vaccination" as used in this paper means the process by which cowpox is introduced from one animal into another by inoculation, and refers not only to the mechanical part of the process but to the biological as well. An accident of vaccination will be held to mean any material variation of this process in the individual, from its normal course, either by reason of the modification of normal symptons, by the supervention of others entirely foreign, or by its failure to a greater or less degree to afford immunity.

Vaccinia or cowpox is, in the human subject, a specific disorder characterized by the appearance of a local eruption passing through the

stages of papule, vesicle, and pustule, and associated with more or less constitutional disturbance. The sequence of the various symptoms, and their severity, differ of course in individual cases, as do all other biological processes. When a variation is beyond the limits of normal and when it is not, is so largely a matter of individual judgment that no standard can be fixed that will not be open to criticism or which will accurately define normal vaccination to the satisfaction of all observers. Ordinarily, however, the papule is evident on the third day, the vesicle on the fifth or sixth, and the pustule on or before the tenth. The scab, which is formed by the fourteenth day, usually separates between the twentieth and the twenty-fifth. Some constitutional disturbance is to be expected, and inflammation of the proximal lymphatic glands is usual. It will be admitted generally, however, that the constitutional symptoms should not be of a serious nature; that vaccination should not result in ulceration or in suppuration of the lymphatic glands; that it should not be accompanied by a general eruption; and that the inoculation should result in the production of vaccinia only and not of any other disease.

The accidents of vaccination which have been most commonly met with may be arranged under the following heads: (1) auto-vaccination; (2) modifications of the pock; (3) aggravation of the constitutional symptoms; (4) ulceration of the vaccination wound or suppuration of the neighboring lmphatic glands; (5) eruptions, more or less generalized; (6) extraneous diseases; and (7) failure of vaccination to confer immunity from smallpox.

Auto-vaccination is the result of carrying virus from the original point of insertion to some other part of the body. The transfer of the original virus immediately after inoculation is, of course, possible, but the accident more commonly arises through the transfer of lymph from the vesicle which develops at the site of the inoculation wound. Auto-vaccination depends quite as much on the susceptibility of the patient to the virus as it does on the transfer of such material. After immunity has been established the accidental inoculation can produce no reaction. The rapidity with which immunity develops has not been determined. It is, however, probably dependent upon various factors—such as the character of the virus used, the number of places in which it has been inserted, and the constitution of the patient. As to the time within which auto-vaccination can occur, we cannot, therefore, speak accurately. Auto-vaccination is most apt to occur in children suffering from eczema, intertrigo, or other diseases which lead to scratching. Ordinarily it is a matter of slight import, especially as the secondary pocks are not usually of as severe type as the original. It may readily be perceived, however, that if the site of the accidental in-

oculation happened to be in proximity to the eye, or in the meatus of the ear, serious results might ensue. Inoculation on the nose has occurred, and was doubtless annoying even if not dangerous. Cory reports two cases in which there was a general eruption of vaccine vesicles over the bodies of children, due probably to the transfer of the vaccine virus by means of wash cloths or towels.

Acceleration or retardation in the development of the vesicle, or in its involution, or aberrations of shape or contents, or varying combinations of these abnormalities, occasionally occur. They seem to depend on the quality of the lymph used and on the constitutional condition of the patient—on the latter, especially with reference to partial immunity. These modifications are of no importance except as they affect the judgment of the physician as to their efficiency as means of protection against smallpox. If the involution of the pock be normal, the period at which it begins to develop is probably not essential, certainly not, if the acceleration does not exceed one, and the delay two or three, days. Variations in the shape of the pock, and in its contents, always render it doubtful whether it has any protective value. In any case, however, in which a vaccination pursues an atypical course the immunity of the patient should be tested by revaccination at an early date. Sometimes the effect of revaccination will be to light up the previously dormant inoculation and the pock vaccination will develop alongside that of the revaccination. If arm to arm vaccination is practiced, the lymph from a vesicle which has pursued a course in any way out of the normal should not be used for the purpose of vaccinating other persons.

The amount of constitutional disturbance which accompanies normal vaccination bears no adequate relation to the radical and lasting changes which the process effects in the system. If, therefore, such disturbance occasionally assumes a severe type it should not be a matter of wonder. Exaggeration of the constitutional symptoms may be associated with corresponding severity of the local reaction; if so, it probably depends upon such reaction. It may occur, however, in patients who exhibit nothing abnormal so far as the pock is concerned, and in such it appears to be due to some peculiarity in the physical make-up of the patient. Both causes may, of course, act together; that is, unusual severity of the local symptoms may occur in persons who are more than ordinarily susceptible to the vaccine virus, and in these we find the most severe cases of vaccinia pure and simple.

NOTE—Cory vaccinated a single patient daily for ten days. The ninth day was the last on which any specified result could be produced. Each day's vesicle after the first was modified. Similar results were produced by inoculating supernumerary fingers and amputating them before complete involution of the inoculation. This merely shows that by vaccinating a patient daily for ten days immunity will occur on the ninth day, but as it is not customary to vaccinats daily it determines nothing so far as ordinary practice is concerned.

When the local reaction is excessive, it may be attributed to the method of vaccinating, to the virus used, or to the organization of the patient. The amount of virus used does not seem to have any effect on the local reaction so long as the surface abraded for absorption is not increased. An increase in the absorbing surface will, however, be accompanied by increased severity of such reaction and a corresponding increase in the general symptoms. The introduction of virus in several places, so far apart as to prevent coalescence of the areolæ produces less severe effects than when it is introduced in one place whose area is equal to the combined areas of the several—a result probably due to the fact that the integrity of the tissues is less severely attacked in the former case than in the latter. The method of collecting and storing the virus has more to do with weakening it than it can have to do with increasing its strength. A virus of more than usual potency, if it exists, probably derives its unusual power from some constitutional peculiarly of the calf from which it is derived. Some calves, it is said, produce an excellent lymph, others a poor one; if so, there would appear to be no reason why some should not produce a lymph of more than usual potency. This is a subject, however, upon which more information is desirable.

Excessive reaction when the local symptoms do not vary from the normal must depend on the patient himself. This condition is found most commonly in strumous or nervous individuals, or those who are both. It would appear probable that in those of the strumous diathesis the severity of the constitutional symptoms depends on the development of an excessive amount of vaccinal toxin, or of a vaccinal toxin varying somewhat from the normal in its composition. Of course, the aggravation of the symptoms in those of the nervous diathesis depends on the too ready, or too vigorous, response of the nervous system to irritation. In those of both strumous and nervous diathesis both factors are at work.

It is almost needless to say anything relative to the unfavorable influence which vaccination may have over the course of acute exanthematous diseases if it be performed in persons thus affected. The constitutional reaction of vaccination supervening on the pathological conditions already existing may render them much more severe. In the face of immediate danger it may be necessary to take such risks, but these unfavorable results are so apt to occur that they may be anticipated and when they occur are almost to be classed as the results of design. They can be regarded as accidents only when there has been negligence on the part of the physician, when the vaccination has been done unwittingly during the incubative stage of some one of the contagious diseases, or when some other disease has manifested itself after the inoculation has been made.

In a normal vaccination we should find no evidence of ulceration. Some enlargement of the proximal lymphatic glands in the region of the inoculation is usual. The occurrence of suppuration is conclusive evidence that the wound has been infected, but through what agency the poison has been introduced cannot, in most cases, be determined. Possibly the vaccine virus has carried the pus-producing organisms; perhaps the surface of the arm was imperfectly cleansed before making the abrasion or puncture; maybe the instruments used were dirty; and quite likely after every precaution had been observed in making the inoculation. the wound has been infected through careless or ignorant treatment during the development and involution of the pock. The day of asepsis dawned long ago so far as surgery and obstetrics were concerned, but medical men in many cases fail to observe in vaccinating, the principles of surgical asepsis, and in some cases even the ordinary rules of cleanliness. A fear lest the use of antiseptics may interfere with the potency of the vaccine virus, which is well founded, may have something to do not only with the failure of the physician to use antiseptics, but also, though needlessly, with his failure to make any attempt at asepsis. His neglect in this respect does not exert a wholesome influence over the parent or other person responsible for the care of the vaccination wound. Logically, too, a wound which can be made without care to avoid infection does not require care to avoid subsequent infection, and, therefore, no directions are given, and no steps taken, to prevent it by subsequent dressings. Another factor in the causation of ulceration should not be lost sight of. Animal tissue is able to withstand the assaults of pathogenic organisms in exact proportion to its vitality. Roughness in making the abrasion for the purpose of inoculation, or the subsequent irritation of the wound by clothing or dressings, may, therefore, materially assist in producing infection. Whether a vaccination wound which has ulcerated has established any degree of immunity against smallpox can be determined only by subsequent revaccination, or by an exposure to smallpox. And if the first wound has been severe it is not unlikely that the patient will be as ready to submit to the exposure to smallpox as to another vaccination. Ulceration is most apt to appear about the end of the first week, and its concomitants and sequel in due course. Its onset may, however, be delayed when it has its origin in infected dressings, etc. It is accompanied with constitutional symptoms and possibly with the development of glandular abscesses. In aggravated cases, the termination is septicæmia or pyæmia, and possibly death.

The occurrence of an eruption, either general or local, is one of the commonest accidents of vaccination. Such lesions do not assume any general type, but include eczema, erythema, impetigo contagiosa, lichen

ruber, miliaria, roseola, and various forms of unclassified vesicular and bullous eruptions. What has been denominated a general vaccinal eruption is occasionally seen, but it may be questioned whether it is a true skin symptom or merely the result of multiple auto-inoculation. These complications almost invariably appear within the first ten days after inoculation. None of them are serious, although they very often occasion alarm on the part of the parent and not infrequently on the part of the physician. The occurrence of impetigo contagiosa, particularly if it spread to children other than the one vaccinated, is especially apt to produce unfavorable comment, and suspicion that some serious contagious disease has been introduced into the system of the patient. The occurrence of a general vaccinal eruption may lead to a belief on the part of those in charge of the patient, and of observant neighbors, that smallpox itself has resulted from the inoculation.

What determines the occurrence and the nature of the eruptions which accompany vaccination, we do not know. It is not likely, however, that they result from impurities in, or changes in, the virus, for if such were the case we would find more or less extensive outbreaks among those vaccinated with the same lymph. The multiform character of the eruptions, too, tends to show that they are not due to any specific cause, or that if so, some other influence is at work to modify the form of eruption in individual cases. It is probable, therefore, that the constitution of the patient has more to do with the occurrence of these lesions than has the virus, even if it be not altogether concerned. Not infrequently it will be observed that those who suffer from skin complications are those in whom the cuticle is more than ordinarily susceptible to irritants of all sorts, but this is not invariably the case. So, too, eruptions are frequently, but not always, associated with abnormality in the appearance and development of the vaccination wound. On the whole, then, skin lesions are due to conditions which we do not understand, but which, it is believed, usually have reference to the system of the patient and not to the virus. They are, therefore, among the least preventable of the accidents of vaccination. Fortunately, however, they are not serious so far as refers to present health, and they are without after effects.

The occurrence of any extraneous disease as the result of vaccination is one of the most unfortunate results which can ensue—unfortunate for the patient, unfortunate for the vaccinator, and unfortunate for the cause of vaccination in general. We know now that all such diseases are preventable. We know also that only a small fraction of the varieties of disease which have been attributed to this cause have had any direct relation to it; and that only an infinitesimal part of those cases of disease which have been charged to vaccination, and which

really might have resulted from it, ever had such origin. We have good reason to believe, too, that many of the cases of disease which have originated in vaccination, have been due to neglect on the part of the patient and not to any inherent danger in vaccination or to neglect on the part of the physician.

The statements which have been made by certain misguided persons as to the dangers of vaccination, although exaggerated in many cases and absolutely untrue in others, have done much to create a tendency on the part of the laity to charge any disease to vaccination which occurs after it, even though the time of its occurrence be more or less remote. Thus all cases of gangrene, blood poisoning, erysipelas, syphilis, scrofula, leprosy, and cerebro-spinal meningitis, which appear while general vaccination is being done, may be charged to it. That some cases of septic disease, erysipelas, and syphilis have occurred from vaccination cannot be denied. There is, however, no evidence whatsoever to support the belief that tuberculosis in any form, leprosy, or epidemic cerebro-spinal meningitis, has ever resulted from it.

The occurrence of septic infection in direct connection with the vaccination wound has already been referred to. There have been reported, however, cases in which while the vaccination sores progressed normally a general eruption, probably gangrenous, has occurred, and the case proceeded to a dangerous issue. Cases of this sort, which are, however, so rare that their authenticity may almost be questioned, are apparently dependent upon some obscure form of blood poisoning. The propriety of separating erysipelas from other septic diseases is, possibly open to question, but the manner of its occurrence, and its general recognition as a disease, per se, probably justifies such a distinction. A vaccination wound, like any other wound, may be the entrance point for infection so long as it exists. Infection may be introduced either when the wound is made or at any time thereafter. When we consider, therefore, the very large number of vaccinations which are performed, sometimes carelessly and very often under unfavorable circumstances, we may wonder that erysipelas is not more common than it is. So far as can be determined erysipelas as a complication of vaccination is more common in Great Britain, where arm to arm vaccination has been practiced exclusively until recently, than it is in this country. This is probably due in part to the use of the humanized virus, and partly to the increased chance for infection which results from the necessity of opening the vesicle for the purpose of securing the lymph. It is to be borne in mind that no amount of care on the part of the physician in the selection of the virus to be used, and no amount of care in the operation of vaccination itself, will absolutely prevent erysipelas so long as those responsible for the subsequent treatment of the wound are not

correctly informed as to the proper care of it—so long, for instance, as dirty clothes, dirtier ointments, etc., are applied to it in the course of involution. An analysis of the mortality in England between 1886 and 1891, from vaccination, shows that erysipelas is credited with almost one-half of it. If deaths from the various forms of blood poisoning be added to those from erysipelas and the various maladies related to it, deaths reported as due to "inflamed arms," etc., two-thirds of the mortality is accounted for. In the light of present knowledge all of these were preventable deaths.

The possibility of communicating syphilis through vaccination was at one time denied. That it can be so communicated must be regarded as now conclusively established, though doubtless only a very small proportion of the cases are authentic in which it is reported to have thus originated. It is to be feared that the disease is attributed to vaccination in some cases in order to hide the loose morals of the patient, or, when the patient is a child, of the parents. The transmission of the disease through infected instruments may occur, but if it does it must bespeak the grossest carelessness on the part of the physician. It may occur when emigrants, after compulsory vaccination at quarantine, endeavor to suck the virus from each other's wounds in order to avoid sore arms. The most common source, however, has been inoculation with lymph from a syphilitic vaccinifer. This may occur whether the lymph used be or be not free from blood. Infection may occur when the virus is taken from a very young child who shows no symptoms of syphilis, or from an adult who manifests no specific taint, because the constitutional symptoms have not yet developed. The introduction of syphilis from calf virus is impossible. The course of vaccinal syphilis is the same as that of the disease when it is acquired in other ways. The chancre does not appear before the fifteenth day, and ordinarily not until three to five weeks have elapsed. Ordinary vaccinal ulcers, which are sometimes regarded as syphilitic, may be recognized by their appearance at a date earlier even that that first mentioned. The character of the ulceration, and the after symptoms, will, of course, clinch the diagnosis in any well-observed case. There is no sufficient evidence to shaw that vaccinia and syphilis are in any way essentially related, as has been alleged by Creighton.

Tuberculosis is among the diseases which have been attributed to vaccination. If it did occur we would expect it to appear first in the form of a tubercular ulcer. No record of such has been found. Neither is there any evidence of the discovery of tubercle bacilli in the vaccine lymph, either human or bovine. That the febrile condition induced by vaccination can be the exciting cause of a scrofulous outbreak in one already suffering from that disease may be supposed to be possible, but even this is established.

Tetanus may follow vaccination as it may follow any other wound. The only death which occurred in Porto Rico among the 800,000 people recently vaccinated there was due to this cause. The disease is, however, common in that jurisdiction.

In view of certain published statements alleging that vaccination was the cause of epidemic cerebro-spinal meningitis, as that disease recently prevailed in the District of Columbia, a careful inquiry was made into such cases as did appear with reference to this point. In the cases investigated, 110 in all, no evidence whatsoever could be obtained to connect the two conditions. This finding is sustained by previous experience when vaccination was quite as extensively done, and meningitis did not exist.

The British Royal Commission on Vaccination reports that it has not discovered in all the evidence taken by it, any which connected the alleged increase in the prevalence of leprosy with vaccination, while, on the other hand, much of a strongly negative character was produced.

The occurrence of smallpox after a more or less recent vaccination is ordinarily regarded as due to some idiosyncrasy on the part of the patient. This may be so in some cases. In others, however, it is due probably to imperfections in the vaccination. The mistaking of a vaccinal ulcer for an unusually successful vaccination is not an unheard of occurrence. And as has been said the extent, if any, to which vaccination, accompanied by ulceration, affords protection is an open question. Another phenomenon which may leave the physician in doubt is the development of a raspberry excrescence at the site of the inoculation. The protective value of this reaction is doubtful, and the conditions upon which it depends are not understood. Disregarding, however, occurrences like these, the question arises whether the insertion of lymph at a single point is sufficient to afford complete protection even temporarily. To this the answer must be that it may do so in some persons, but that in others it will not. And it seems to be established that in any case the loss of immunity occurs more quickly when the virus has been inserted in only one place than when several have been inoculated. It is, too, reasonably well established that usually, if not always, if vaccination will not take there is immunity to smallpox. The converse is also probably true, that so long as vaccination will take there is susceptibility to variola. If these propositions be sound, repeated vaccination until the inoculation produces no result—vaccinization would appear to be the only basis on which it would be proper to predicate complete immunity. If the vaccination be not done until after infection, there is, in my opinion, but little reason to prophesy immunity or even a modification of the disease.

The occurrence of fatal results after vaccination is extremely rare. The returns from England, from 1881 to 1889 inclusive, where arm to arm vaccination has been practiced almost exclusively, show one death for each 14, 159 primary vaccinations. In Scotland, from 1883 to 1890 inclusive, the proportion was one to 38,872. If two-thirds of these deaths were due to septic disease, blood poisoning, and erysipelas, which was probably the case, the number of deaths which may have been due to vaccination, per se, is greatly reduced. In fact, if allowance be made for errors of judgment as to the advisability of vaccinating doubtful cases, it may be questioned whether all of these deaths cannot be classed as preventable. In the District of Columbia there have been more than 50,000 vaccinations done within recent years without a death. And in Porto Rico, where 800,000 vaccinations have been done among a people, many of whom are ignorant and dirty, there was but one death, and that was due to tetanus, a disease which is very prevalent there.

In undertaking to determine the cause of any particular accident of vaccination we meet with a most difficult problem. The factors concerned are: First, the virus; second, the organism of the patient; third, all means which are employed to bring the two into such relation as to result in vaccinia; and fourth, the treatment of the pock. Such an accident may be due, therefore, to bad virus, or to the condition of the person vaccinated, or to improper methods of vaccinating, or to improper methods of caring for the vaccination wound; or they may be due to the combination of any one, two, three, or four of these causes. To determine, therefore, what the cause has been may be impossible.

Accidents due to the virus may depend upon imperfections in the source of such material, or upon its improper collection, storage, or use. As has been intimated, the liability of conveying specific diseases is greatly increased by the use of humanized virus; in such cases both vaccinifer and vaccinated are susceptible to the same pathological processes, while, on the other hand, many diseases are not common to the bovine species and to man. There is no clear evidence of the transmission of any bovine disorder to the human being by means of vaccination from the cow. Even if diseases could be transmitted to man from the cow, such accidents are rendered practically impossible by the examination of the calves physically and by the tuberculin test before they are inoculated, the killing and examination of them post mortem by competent veterinarians after the lymph has been collected, and the rejection of all lymph which has come from animals in any way diseased, which is now the practice at all first-class vaccine establishments. The subsequent glycerinization of the lymph which is ac-

cepted, its bacteriological and clinical examination, and the issue of it in hermetically sealed tubes or other receivers containing lymph for a single vaccination, all tend to reduce the liability of the occurrence of accidents from bad virus. The other factors having to do with the causation of accidents due to the virus have already been dealt with at sufficient length in considering the nature of the various unusual and unpleasant complications of vaccination.

After all, what most concerns this Association is the question of prevention. The use of calf lymph instead of that from the human being is in this country so general as hardly to require comment. When we remember that by using the animal virus we are able to determine absolutely the physical condition of the animal from which it is taken, that syphilis certainly cannot be transmitted through it, and that the chances of other diseases being carried is very much reduced, we may wonder that the use of human virus was not long ago everywhere discontinued. Some physicians, though, cling to it, believing that the resulting symptoms are less severe. There appears, however, to be no reason why there should be a material difference between the severity of the symptoms following the use of calf lymph and those following the use of human lymph. The first step then toward the preventing of accidents of vaccination would seem to be the general use of calf lymph.

So long, however, as the physician is at the mercy of the manufacturer and can only determine the quality of the lymph which is being supplied to him by the more or less unfortunate results which ensue in his practice, accidents will occur. The State requires vaccination in many cases. In fact, it may be said almost without question that nearly all vaccination which is done is done because of State regulations. It would appear, therefore, desirable that the State should in some way see that the vaccine virus sold is of such quality as to prevent accidents in its use. This can be accomplished only by each State assuming supervision of all vaccine farms within its limits, and by it permitting the sale of vaccine matter only after official test and approval, and subject to State regulation.

Such investigations as have been conducted in this country and elsewhere seem to show conclusively that the glycerinization of vaccine lymph will kill all extraneous organisms which may be in it. Streptococci and staphylococci are destroyed, and in cases where diphtheria and tubercle bacilli have been mixed with lymph for experimental purposes they have promptly disappeared. It appears advisable, therefore, that all lymph should be properly glycerinated before use.

If human virus is to be used the physician should know definitely the history of the patient from whom it is taken. It is hardly necessary

to say that none should be taken from a child suffering from either scrofula, syphilis, or other contagious disease. None should be taken from children less than three months old, because of the danger of undeclared syphilis, and none from adults because of the danger of undeveloped recently acquired syphilitic contagion. Under no circumstances should lymph be taken from vesicles which have been accelerated or which have been retarded in their involution, or which are in any way abnormal.

In order to prevent accidents because of ignorance or carelessness on the part of physicians, it seems to me proper that steps should be taken to teach in our medical schools more thoroughly than at present the importance and dangers of vaccination, and the proper method of vaccinating. Until this has been done it must not be a matter of wonder that bad arms occur through ignorance or neglect on the part of physicians. The glycerinated lymph in capillary tubes, provided the tube contains sufficient material for a single vaccination only, affords practical safety against infection through the virus. The physician must understand, however, the importance of cleaning the arm of his patient before making the insertion, and of using for the purpose of abrading the skin or of making the puncture some instrument which has been recently sterilized. The immediate care of the arm after the operation also concerns the physician, and he should see that it is not exposed to any material likely to infect the wound, such as dirty shirt sleeves or filthy bandages. If vaccination shields are to be used it is his business to see that they are of the sort suitable for the purpose and are properly used. In addition, however, to knowing how to vaccinate it is important to know when. Of course, in the face of an impending epidemic risks must be taken with reference to accidents of vaccination in order to render more or less certain the avoidance of smallpox, but even here discrimination is desirable. The advisability of vaccinating extremely young infants unless it is probable that they will be, or have been, exposed to contagion is, in my judgment, more than questionable. Similarly with reference to patients suffering from scrofula, syphilis, erysipelas or the exanthemata; it is certainly only the gravest emergency that will warrant vaccination. By this we do not mean to accept the general impression that the physical condition of every child forbids vaccination so long as the parents believe that it does. Many cases occur in which healthy, rugged children are asserted by more or less nervous parents to be so delicate that they cannot be vaccinated, when exemption is sought from the regulation requiring the vaccination of children before admission into the public schools. The physician, therefore, should be taught in his college course how, when, and who to vaccinate. He should be taught to discriminate between suc-

cessful vaccinations and those which have been unsuccessful, and as to the proper course of procedure if the first vaccination fails.

Most of the sore arms which are now chargeable to errors on the part of parents or others responsible for their care are due to ignorance rather than to wilful neglect. On this account the physician should be able to instruct such persons as to the proper care of the vaccination wound, as to the best form of dressing, and as to the importance of saving the arm from irritation and of preventing children from carrying the virus from the pock to other parts of the body. Possibly in all cases, certainly in all where vaccination is done on an extensive scale, definite instructions as to the care of the vaccination wound should be formulated by the sanitary authorities and printed in such form that the vaccinator may leave a copy of them with the parents or other responsible person in each case in which he effects a vaccination. Oral advice may be forgotten, but printed circulars containing instructions will be available for reference.

So far as refers to the occurrence of smallpox in persons recently vaccinated, it seems to me that vaccinization is worthy of more attention than it receives. Too many of us believe that a single point of insertion is sufficient. The observations abroad, however, seem to show that security from the infection of smallpox depends to a greater or less extent on the number of vaccination scars. In order to prevent the occurrence of this disease it would seem desirable, therefore, to insert the virus in several points, at the same time or successively, so that the system may be entirely robbed of its susceptibility to vaccinia, and, therefore, presumably of its susceptibility to smallpox.

And finally, we may conclude with the British Royal Commission, that, although some of the dangers said to attend vaccination are undoubtedly real and not inconsiderable in gross amount, yet when considered in relation to the extent of vaccination work done they are insignificant; that there is reason to believe that they are diminishing under the better precautions of the present day; and that with the addition of the further precautions which experience suggests they will decrease even more in the future. And even at present, when compared with the good accomplished the accidents of vaccination are of but infinitesimal moment.

A CAUSE FOR UNSUCCESSFUL VACCINATIONS.

By Dr. MIGUEL MARQUEZ, of Chihuahua, Mex.

There is a cause for the frequent unsuccessful attempts at vaccination, which is easily avoided, and depends largely upon the much used method of scraping the skin.

Among the many disadvantages arising from this method there are some which seem to us of vital importance. In the first place, the flow of blood which follows the process of scraping the skin, proves a hindrance to the free absorption of the lymph; and if great care be not taken to check the flow, inoculation does not take place and in consequence the vaccination proves a failure.

In other cases there may be a perfect absorption of the lymph and within two or three days there may appear a few small pimples or ulcers the character of which could in nowise justify the conviction that the operation has been successful; for there is but one peculiar scar whose characteristics can guarantee the immunity to smallpox.

Again there frequently arise accidents of such serious character from this method of sacrification, that we have many times seen the lives of children in danger from diffuse phlegm, erysipelas, gangrenous sores and specific infections, notwithstanding the fact that the operation has been performed with rigorous asepsia and antisepsia precautions, and with lymph of the most approved quality.

One of the strongest objections to this method, to say nothing of its painfulness, and in spite of the fact that it is practiced in accordance with the dictation of science, is that the wound which it leaves may become a focus for infection, and in the end the scar which it leaves is apt to be of a very irregular nature, and very seldom presents the peculiar characteristics that are necessary as proof that one is perfectly immune to smallpox.

All of these inconveniences may be avoided by inoculating by the simple puncture method, which, while not causing the slightest pain, neither permits infection nor the transmission of any other disease, and when it is well practiced is seen to be an operation so painless and simple that it can be performed by any person, either by means of a small lance or a simple needle; care being taken to adhere to the following directions:

Let the aseptic lance first be moistened in the lymph, then taking the arm in the left hand in such a manner as to hold the skin as firmly as possible, prick the skin in three places, the first about two inches below the shoulder, and the other two either below or on each side of the first at a distance of about an inch. Each puncture will be made by introducing the point of the lance or needle into the skin in such a

manner as not to draw the blood. Upon withdrawing the instrument care should be taken to lift the blade and slightly turn it, so as to leave the lymph in the puncture. Each arm should receive at least three punctures. In reference to this last fact, Dr. Mason, of the London Smallpox Hospital, has given us very interesting statistics. As head physician of the hospital during the last twenty-five years, he has had occasion to observe the vaccinations of 6,000 individuals with the following results, the number of deaths being in exact proportion to the number of apparent scars, thus: The mortality of individuals having been vaccinated but possessing no scar was 21, 7 per hundred; those having but one scar, 7, five per cent.; with two scars, 4, 12 per cent.; with three, 1, 7; of those having four or more, 0, 7 per cent., leaving the mortality of those not vaccinated 35.5.

The inoculation being made, no effect is observed until the fourth or fifth day, when there appears in each puncture a small red pimple, which produces a slight itching, and on the sixth day is transformed into a small blister, rather flat in appearance and slightly hollow in the center; by the eighth day this has grown to the size of a pea, is of a grayish white color, the flesh surrounding being slightly inflamed, swollen and hard. On the ninth day the clear liquid of this blister is transformed into the real pus, which by the fifteenth or eighteenth day has dried into a scab; when this falls off there is left a scar which will never disappear, of a lighter color than the surrounding skin, and having its surface marked with darker spots.

The vaccination which has been performed according to the above directions and whose scar at the end of the eighth day presents the characters above described should be considered a sufficient guarantee that the individual is immune to smallpox for the remainder of his life. Consequently revaccination is unnecessary.

The following table shows the number of inhabitants in Chihuahua, Mexico, number of American inhabitans, general mortality, mortality by smallpox, number of vaccinations, revaccinations and their results, give us some idea of the matter:

Year	Number of Mexican Inhabitants	American Inhabitants	Total number Inhabitants	General Mortality	Mortality from Small Pox	Vaccinated	Re-vaccinated, Mex'n	Re-vaccinated, Am'n	Total Re-vaccinated
1893	18985	575	19560	849	00	795	125	215	340
1894	19753	517	20270	800	00	322	74	79	153
1895	19903	570	20475	808	00	847	141	144	285
1896	20755	753	21508	944	00	762	139	202	341
1897	22892	831	23725	677	00	787	132	145	277
1898	27207	1028	28235	970	07	921	101	77	178

From this we see that during the last seven years there have been but seven deaths caused by smallpox, and these were of children who had never been vaccinated, and Americans having been vaccinated by scarification. Not one person vaccinated by puncture has been attacked by smallpox. Recently there has been quite an epidemic, to which many Americans have fallen victims, causing a mortality of 50 per cent. Out of 1,594 revaccinations, 862 have been of North Americans and 712 of Mexicans, Germans, French, Spanish, Irish and Chinese. The first 775 proved successful, that is to say 89 per cent.

Among the Mexicans only about 2 per cent. took effect, which proves clearly the perfect immunity which they have acquired. This is further confirmed by the fact that they do not fall victims to the smallpox.

The above facts being the result of our experience and observation, we deem it wise to advise the adoption of the following rules for the inoculation of vaccinal lymph. These rules have been formed by the Board of Health of Mexico and slightly revised by the writer. We very much desire the free circulation of these directions throughout all localities in the Republic, hoping that by their strict observance the dreaded disease will disappear entirely from our country:

I. Vaccination is an effective preventive of smallpox.

II. It can be administered at any season of the year.

III. No danger is incurred in being vaccinated, even though there be an epidemic in the locality.

IV. During the first months of infancy one should be vaccinated.

V. Inoculation is a simple, painless operation, and when properly done admits no danger of infection or the transmission of any disease.

VI. The lymph used should come directly from the sore or should be that preserved in small tubes or glasses.

VII. Lymph coming directly from the running sores of calves is preferred, especially for vaccinations.

VIII. The place for the inoculation should be well washed with water and antiseptic soap, and afterward with absorbant cotton moistened in a solution of .002 bicloride or boric acid .04, being careful to dry perfectly before proceeding.

IX. The sore is pricked in different places with a lance or needle, care being taken not to draw blood.

X. In the transparent liquid which escapes the point of the lance is well moistened, then holding the arm of the person firmly in the left hand, the flesh is pricked in three places, the first about two inches below the shoulder, and the other two either below or at each side of the first at a distance of one inch.

XI. These pricks must be made with only the point of the lance, and in such a manner as not to draw blood, being careful upon withdrawing it to lift up and slightly turn the blade so as to leave the lymph in the puncture.

XII. For each arm vaccinated the lance must be freshly moistened in the lymph.

XIII. If the lymph preserved in the tubes is to be used both ends of the tube are broken; then by means of small rubber bulb, the liquid is softly blown from the tube, and as it drops is received on the point of the lance, and inoculation is performed according to the directions given in X.

XIV. No change is noticed in the appearance of the vaccination until the third day.

XV. Upon the fourth day a small red pimple is noticed in the center of each puncture; this continues to increase in size and produces a slight itching.

XVI. Upon the sixth day this pimple is transformed into a small blister, in appearance a little flat and slightly hollow in the center. This continues to increase in size until the eighth day.

XVII. On the eighth day the vaccination presents the following characteristics: Its size is that of a pea, has a grayish white color, the flesh surrounding it is seen to be inflamed, swollen and hard.

XVIII. If at this stage the sore should be pricked, a clear liquid would flow out; this is the vaccinating lymph.

XIX. At the ninth day this liquid is converted into real pus, which begins to dry and by the fifteenth or eighteenth day has formed a dry scab, which loosens and falls off, leaving behind a scar which never disappears.

XX. The scar proceeding from a vaccination is of lighter color than the surrounding skin, and shows on its surface darker marks.

XXI. Only vaccinations which have been performed according to the above directions and whose appearance on the eighth day have presented the characteristics above described, should be considered successful.

XXII. The fact that but one of the punctures produces a sore is sufficient evidence that the child is legitimately vaccinated, and consequently will be protected from smallpox.

XXIII. If it be possible the vaccination of children should be examined and pronounced efficacious by a physician.

XXIV. If the inflammation around the vaccination should become very intense, a powder composed of the following may be used:

Talcum powder	100 gr.
Boric acid	15 "
Salicylic acid	1 "

Or Johnson and Johnson's Baby Powder, the vaccination should be immediately covered with antiseptic cotton.

XXV. To avoid accidents, which sometimes occur during the period of vaccination it is well:

I. Never to vaccinate a person who has fever, nor any individuals who may be affected by any epidemic or contagious disease.

II. To avoid all counter irritation of the region inoculated, for which the protectors furnished by Johnson and Johnson may be used, also those of Whital Tatum serve the same purpose.

III. To avoid tumors (abcesses) and other eruptions, lymph should not be used from vaccinations that are exceedingly inflamed.

IV. Not to vaccinate when there is erysipelas epidemic in the locality.

V. Never to use lymph which is adulterated or in putrefaction.

REPORT OF COMMITTEE TO DEFINE WHAT CONSTITUTES AN EPIDEMIC.

By Dr. U. O. B. WINGATE, Chairman.

Mr. President and Members of the Association—In the first place your committee desires to express its profound sorrow in the loss of one of its members by death, our lamented President, Dr. George H. Rohé. His experience in, and knowledge of the subject of sanitation was such that your Committee feel that his decease has caused an irreparable loss in the work required in attempting to present this report.

The Chairman of your Committee has corresponded with other members of the Committee, and has received numerous replies, and found that to define the word "epidemic" in the sense used by most health officers was an extremely difficult task. One member of your Committee expressed the idea that we should attempt to abolish the word "epidemic" entirely from sanitary language and from our laws, but this, it has seemed to your Committee, was an impossibility. The word "epidemic" is so interwoven in the history of sanitation, and has become so common in the language of the people and in our laws, that an attempt to abolish it would be quite impossible, in our judgment. Large works have been written on the history of epidemics, and one quite recently has been published in two large volumes entitled, "The History of Epidemics of Britain from A. D. 664 to 1893," and the word appears in the laws of many of our states.

The object sought for in the work of your Committee was to formulate some brief and clear definition of the word that would generally be accepted by sanitarians, and health officers, with the hope that the same would be accepted by the courts, if a definition could be formulated that could be adopted by this Association and placed before the public. While it is not expected that a definition can be employed that will be perfect, it is believed that the word can be defined in such a manner as to aid very materially in the operation and execution of sanitary laws. Thus far we have nothing that defines an epidemic except that which is published in Rohé's text-book on Hygiene, and which was promulgated by the New Orleans Medical and Surgical Association.

"An epidemic is said to exist, by the decision of this Association, when the following per cent. of a population is effected:

For a population of				100,			5	per cent
"	"	"	"	500,			4	" "
"	"	"	"	2,000	to	5,000,	22½	" 1,000
"	"	"	"	6,000	to	10,000,	16	" 1,000
"	"	"	"	20,000	to	50,000,	8	" 10,000
"	"	"	"	50,000	to	100,000,	4	" 10,000
"	"	"	"			200,000,	1	" 10,000

It can readily be seen that this definition is very defective and unsatisfactory. What every health officer desires to know is what an epidemic really is, how many are effected, and what is the character of the outbreak, and we must take under consideration two factors in giving an intelligent definition to this term:

First. Number of cases.

Second. Rapidity in which the disease spreads; and it seems to be an impossibility to eliminate either one of these factors.

After a considerable amount of correspondence and consideration of the subject, your Committee, with the exception of one member, has decided to recommend for adoption by this Association, the following as a definition of "an epidemic":

"An epidemic is an outbreak of a communicable or infectious disease, affecting a dozen or more individuals in quick succession before the recovery of the first case, whether arising from a single focus or from several foci in a neighborhood."

Respectfully submitted,

U. O. B. Wingate,
F. Montizambert,
Benjamin Lee,
Committee.

THE OFFICIAL DEFINITION OF DIPHTHERIA.

By HIBBERT WINSLOW HILL, M. D.,

Director of the Bacteriological Laboratory of the Boston Board of Health, Boston, Mass.

Mr. President and Gentlemen—In the practical application of bacteriology, pathology and clinical medicine to the requirements of the modern systems for the supervision of infectious diseases, the need is often felt for authoritative and widely accepted definitions, covering all the aspects of such diseases in their various relations to the public health, the public convenience and the public safety. In no disease is this lack of definition more evident than in the case of diphtheria. Perhaps no disease has been more discussed, certainly no disease is better known or understood, yet one hears again and again the question asked, where shall the line be drawn between diphtheria and not diphtheria? This question is asked publicly and privately, by the profession, by health officials and by the laity. It has been answered also again and again—piecemeal, it is true. What I have the honor to suggest to this committee and through the committee to the Association is simply that the Association representing, as it does, the profession of health protection (if I may so call it) throughout the whole of the American continent, containing in its membership those best qualified to recognize and to meet the difficulty, as well as those whose collective pronouncement carries the greatest weight,—that this Association should render a clear and full statement of the case, so far as is now possible, in order that hereafter we shall have some one definite accepted authority to which we can refer and on which the necessary regulations of the various health boards may be based, so that a co-ordinate and logical uniformity on this matter may have an opportunity for existence in this country.

Having taken upon myself to suggest this measure for the mutual benefit of our membership, as it seems to me, I have ventured further to add here a brief outline of the main points to be considered as a basis of discussion and, if they be approved, of action by this Association.

The subject, after all, is comparatively simple.

The theory of the disease of diphtheria, must be here briefly recapitulated. The first factor in the production of the disease is the patient; the second is the bacillus of diphtheria. Given a combination of patient and bacillus, a long series of possibilities arise. Were all diphtheria bacilli equally virulent and all patients equally susceptible, such

a combination of bacillus and patient would result in a definite set of pathological changes in almost all cases and leave little room for indecision in diagnosis. But because of the wide variations in the degree of virulence of the bacillus and in the degree of resistance of the patient, the pathological changes essential to the disease which are the resultant of these two forces (leaving out of the question for the present the effect of environment or of treatment) may be entirely absent, and when present vary in degree almost infinitely. Nevertheless, certain distinct classes may be recognized, and these classes give the key to the situation.

The evidence accumulated in the last few years allows us to believe that we may classify the bacilli into two main groups, virulent and non-virulent, and patients into two groups also, resistant and non-resistant. The virulence or non-virulence of a given diphtheria bacillus may be determined by animal inoculation. This admits of some discussion perhaps, but for our present purposes, we may accept the test as giving a basis for consideration. The resistance or non-resistance of the patient can be determined only, in any specific case, by the development or non-development of the disease, after infection with a virulent organism. This also is a determinable factor in some cases at least. Granting so much then, four classes of cases arise in which bacilli may be found.

Class 1. Non-virulent bacilli found in the throats of resistant subjects.

Class 2. Non-virulent bacilli found in the throats of non-resistant subjects.

Class 3. Virulent bacilli found in the throats of resistant subjects.

Class 4. Virulent bacilli found in the throats of non-resistant subjects.

Cases falling under classes 1 and 2 are probably rare and are not likely to be found except in epidemics or in other circumstances where wholesale bacteriological examinations are made, because ordinarily there would be nothing to call attention to the subject of such infection.

Class No. 3 in which virulent bacilli are found, producing, however, no lesions, on account of the resistance of the subject, are frequently met with.

Class No. 4 includes all the cases of clinical diphtheria—that is, where pathological conditions are present and are sufficiently marked to call attention to the patient.

So far then, we have arrived logically at the conclusion that the problem presented is to decide whether "diphtheria" is patient + diphtheria bacillus simply, or patient + diphtheria bacillus + typical lesions.

I think it will be admitted that the first combination, patient + diphtheria bacillus alone, does not predicate a disease at all—since the essential element of disease is pathological change—and if that combination is not a disease, it cannot be the disease of diphtheria. Nor is it logical to assert that patient + diphtheria bacillus + typical lesions necessarily constitutes diphtheria although that formula will cover most cases. The typical lesion which attracts most attention and to which we may confine ourselves for the present purpose is an inflammation of the throat, or more definite still, the presence of a pseudo-membrane. If such inflammation, or pseudo-membrane never occurred except as a result of the presence of the diphtheria bacillus, then patient + diphtheria bacillus + inflammation or membrane would be decisive. To such a combination and to such only could the term "disease of diphtheria" be applied. But both inflammation and pseudo-membrane, indistinguishable in practice at times from those produced by the diphtheria bacillus, are of frequent occurrence—the bacilli nevertheless being absent. Moreover upon such membranes, often due to streptococci, may be implanted diphtheria bacilli, both non-virulent and virulent forms. Thus the combination patient + diphtheria bacillus + pseudo-membrane may exist, where the pseudo-membrane is due to a streptococcus solely. Such a case constitutes a disease certainly, but not necessarily the disease of diphtheria. Lest anyone should object that this is a purely hypothetical case, I may cite the not infrequent finding of diphtheria bacilli in the throats of scarlet fever patients suffering from a streptococcus pseudo-membrane, the diphtheria bacilli producing no appreciable effect whatever. It would be no more logical to say that such a patient was suffering from diphtheria because the combination of patient + diphtheria bacillus + pathological changes (due to the streptococcus) was present than to say that patient + diphtheria bacillus + pathological changes (due to the typhoid organism) constituted diphtheria.

It seems plain then that the only possible combination which we can logically recognize as the disease of diphtheria is not patient + diphtheria bacillus + typical lesions, but *patient + diphtheria bacillus + lesions, due to the diphtheria bacillus.* Given this combination, the additional presence of an active streptococcus in the throat does not invalidate the diagnosis of diphtheria any more than would the additional presence of an active typhoid organism in the intestine.

It is evident that the reasoning here used will apply equally well to any other parasitic disease. My only reason for presenting so obvious a conclusion depends on the confusion which sometimes exists amongst the public, and even the profession, especially when the question of reporting a doubtful case comes up. Thus, a positive culture is

obtained from a healthy throat, or from a throat showing the mildest of lesions, or from a streptococcus throat in scarlet fever or other acute specific in which the previous diagnosis was established and the diphtheria bacillus discovered later shows no clinical indications of activity. Thereupon, the attending physician, and the legal medical officer of the district may be in doubt as to the proper classification of the patient. To the physician, the recognition of the pathological changes and the determination of their cause is the important matter. To the medical officer, the diagnosis, so far as the patient's welfare is concerned, is of less importance than the protection of the public health. To the one, the presence, or absence of the diphtheria bacillus is regarded chiefly as an aid to diagnosis; to the other, the presence or absence of the bacillus is the essential point at issue. The physician wishes to fortify his patient against the disease of diphtheria, the medical officer desires to protect the public from the bacillus of diphtheria. If a hypothetical case be considered in which the disease of diphtheria was produced by inoculation with the toxin of diphtheria only, the bacilli of diphtheria being absent, the physician would still have the interest of his patient to consider, while the medical officer might go his way free of responsibility. In the far more frequent cases where the bacillus is present, but the toxin absent or ineffective, it is the physician who is relieved of responsibility, whereas the medical officer's duty to the public remains to be performed.

To apply the foregoing considerations to actual practice, it must be remembered that it is impossible at the present time to observe such rules of procedure as will meet every possible condition here outlined. For instance, it is usually impracticable, from the executive standpoint, to determine in every case the virulence or non-virulence of the bacilli found by the bacteriologist,—certainly it is impossible to determine it in time to be of service in diagnosis. It is necessary then to assume that all the diphtheria bacilli detected are virulent and experiment confirms the natural expectation that such an assumption is correct in the great majority of cases. Again, in any specific case when the diphtheria bacillus is present accompanied by lesions similar to those usually produced by this bacillus, it is often impossible at present to determine immediately and absolutely that those lesions are due to the diphtheria bacillus rather than to other organisms which may be also present. Here again it is usual to assume that the diphtheria bacillus is the cause of the lesions it accompanies,—and this assumption also is usually true. The evident necessity for making these assumptions in practice, perfectly right and proper as such assumptions are in the majority of cases, is just exactly the necessity which gives rise, in the minority of cases, to misunderstanding and confusion. Nor do I

think that the uneasiness and distrust sometimes felt when specific cases arise in which the assumptions appear to be in error to those who do not clearly follow the reasoning on which such assumptions are based will ever be removed unless that reasoning is presented clearly and forcibly to them.

Leaving on one side, however, this matter of obtaining an intelligent and harmonious coincidence of opinion and practice in these matters, it seems to me that the remedy for the uncertainty in diagnosis and for the legal complications which may sometimes ensue lies in the hands of the health authorities, in those cases at least where diphtheria bacilli are found, and I am convinced that this aspect of the case permits of adjustment at once scientific and practical, theoretically correct and executively wise. In short, it seems to me that it is advisable for health authorities to recognize a distinct difference between that condition in which the diphtheria bacillus is present and active in producing lesions and that condition in which the diphtheria bacillus is present but produces no lesions. To my mind, the former condition only can be classed as the "*disease* of diphtheria," while the latter must be pronounced as "*not* the disease of diphtheria." Notwithstanding this, however, I would further emphasize what appears to me an important necessity, that is, the definite recognition of this condition of "not diphtheria, but diphtheria bacilli present" as a condition dangerous to the public health because of the opportunity afforded for the infection of others from the diphtheria-infected patient, whether the patient be in health or suffering from the activities of some other organisms. It is not that I believe this distinction to have been overlooked that I suggest its definite recognition in terms—but merely to secure the advantages that such definite recognitions by this Association may carry.

TO SUM UP.

The disease of diphtheria is existent only when an active diphtheria bacillus, producing recognizable lesions, is present.

(In many cases, the clinical evidence is so complete that the presence of the bacillus may be inferred for diagnostic purposes without actual microscopic examination. It is nevertheless advisable that its presence should be demonstrated in all cases.)

The presence of diphtheria bacilli without the production by them of recognizable lesions, does not constitute the disease of diphtheria; such patients, nevertheless, constitute to others possible sources of infection and of development of the disease. The necessity for isolating persons suffering from the disease, in order to prevent the spread of the disease, has long been recognized. It would appear to be the

proper time now to go further and to isolate persons carrying the bacillus, as an additional precaution against the spread of the disease.

In order, then, to place the matter on a definite basis, it is suggested that this distinction be recognized by so wording all regulations relating to the supervision of diphtheria that, in so far as may be advisable for the protection of the public health, the demonstration of the presence of the diphtheria bacillus should be sufficient to empower health authorities to proceed with measures directed to prevent its dissemination. As an example of what seems to me advisable, I would suggest that such phrases occurring in these regulations as "persons suffering from diphtheria" or "cases reported as diphtheria" should be modified to read "persons suffering from diphtheria or infected with diphtheria bacilli" and "cases reported as diphtheria or as infected with diphtheria bacilli." To me, it seems that a simple change of wording in line with these suggestions will give the necessary power and protection to health authorities while absolving them from any charges of wrenching terms to suit misunderstood conditions, such as are sometimes, although unjustly, now brought forward.

THE NATURE TREATMENT OF TUBERCULOSIS.

By R. O. BEARD, M. D.,

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There is no question of more dominant interest to-day to the profession of medicine, to the student of sanitary science or to the general public,—which depends upon both for its enlightenment in matters of disease,—than the question of the possible prevention and cure of tuberculosis and, especially, of tuberculosis in its pulmonary form. The pregnancy of this question is growing with the public recognition of the prevalence and fatality of the white man's plague. Its solution is coming to be in the popular,—as it has long been in the professional mind,—a matter of urgent demand. Perhaps nothing has contributed more to this awakening of the public consciousness to its own dangers from tuberculosis than the failure and the consequent disappointment which followed, some years ago, upon the introduction of Koch's tuberculin. "It is better to fail than never to have any striving that is worth being called a failure," for it is so often true that the mistakes of to-day are the stepping stones to achievement on the morrow. Koch did more for the future control of tuberculosis than to discover the tubercle bacillus. He did more than to put into the hands of the medical world an agent of diagnosis which has proved and is destined to prove of inestimable value in the discovery of disease in men and animals. If he overshot the therapeutic mark, he pointed to a target of treatment which men have since sighted with greater success. If he did not find a curative agent, he suggested a scientific method of dealing with disease in its use. If he did not solve the problem whose solution we are still seeking and toward the solution of which so many other abortive attempts have been directed, he stimulated professional inquiry and aroused popular consciousness to the possibilities of relief.

In the science world, as in the world of commercial values, demand is the constant stimulus to supply. When human society learns the economic value of human life and appreciates its waste—in a single direction and by a single cause—to the proportion of ten per cent. of its total, it will not be long before it writes an equation in which the third factor to be found by the sanitarian will be that of cure. And that we are several steps nearer to the finding of that required factor is largely due to the generally discredited labors, as well as to the earlier accredited discoveries, of Robert Koch.

The indications of the growth of this popular professional demand are everywhere manifest. They are seen in the enactment of ordinances in our great cities prohibiting expectoration in public conveyances and, in some notable instances, requiring the report of cases of pulmonary consumption to the health authorities. They are seen in the publication of popular tracts and official directions concerning the avoidance of contagion and the destruction of diseased sputum. They are seen in the actual agitation, in a great commonwealth, of popular sentiment for the quarantine of a whole state against tuberculous pilgrims in search of climatic relief. They are seen in the organization, in several states of the Union, of societies for the prevention of tuberculosis. They are read in the formula of the objects of these bodies, well illustrated by the constitution of the Illinois Society, which is "to educate public opinion in the doctrine of the contagiousness of the disease, to instruct the public in practical methods of avoidance and prevention, to visit the consumptive poor and supply them with the necessary materials with which to protect themselves against the disease, to furnish them with hospital treatment, to co-operate with boards of health in preventive measures, to advocate the enactment of preventive laws and to establish branch societies throughout the State."

They are seen in the establishment of sanatoria and hospitals for the exclusive care of consumptives in certain of our great cities. They are shown in the special precautions which are being taken for the isolation of tuberculous patients among the inmates of insane asylums, schools for defectives, and penal institutions.

They have been evidenced, within the past few months, by the assembly at the city of Berlin of an International Tuberculosis Congress, which was conducted with success—a success which is none the less important because it is rather popular than professional in its results. That success lies, not in the discovery or announcement of new facts or principles, but in the organization of agencies by which these known facts and principles may be applied. It means, as an operative influence, no especial stimulus to that patient effort of the pathologist, the clinician and the sanitary scientist which goes on unhasting and unresting still, but a stimulus to the practical employment of those means and measures which are the birth of the pathologic and sanitary science of to-day.

And, finally, these indications of a popular and professional demand for a realization of results are seen in the proposed or accomplished dedication of large tracts of land and forest and lake as great public parks for the sake, among other desirable ends, of their preventive and remedial possibilities as great national or provincial health resorts.

All of these activities have been inspired primarily by the study of the etiology and course of the disease which has been going on, since the day of Koch's initial discovery, in the laboratories of pathology and bacteriology throughout the scientific world. This study of the warfare which is waged between the human tissue cells and the bacillus tubercuolsis has taught us and is teaching us, more and more forcibly, the practical lesson that the task of the public sanitarian and the physician is largely one of prevention, and that cure—a secondary and short-lived possibility in the course of the disease—is best to be accomplished by extending the principles and methods of prevention to the assistance of the tissue-cells in their life and death conflict with the disease. It means, on the one hand, to make the conditions of human life as favorable as may be for the integrity of the tissue-cells and as uncomfortable as possible for the tubercle bacillus. It means, on the other hand, to make the self-same conditions of human life which will sustain that integrity operative for its restoration under attack. It means something in the way of hope for the future, when the statistics of human health in the large cities, even, of the Northwest show a phenomenally low death rate and when we learn from the lips of Minnesota bacteriologists that, in this region, their germ cultures have a provoking tendency to die out. In the adjustment of these two tendencies to each other we may obtain demonstration of the possibilities which hygienic measures afford for the maintenance or recovery of resistance upon the part of these tissue-cells to disease.

Strange, is it not, how intuitive is the quality of ideas which spring into action before the reason for their existence can be discovered. Modern science re-equips the old hypothetic notion of the vis medicatrix naturæ with the dignity of a demonstrable fact; and that fact gives us the impetus to the most hopeful movement of modern medicine toward what may be fitly termed the Nature Treatment of Tuberculosis. There is nothing new in the isolated facts which enter into this, nevertheless, novel conception. No new principles were announced at the International Congress of Berlin and yet the consummate value of the deliberations of that Congress lay in the recognition of a new system of treatment into which old facts fit and in the elaboration of methods by which that system can be practically employed. With a good understanding of these old facts we have been slow—as a child piecing his newly-learned letters into words—to compose them into the lesson that they teach. Long have many isolated cases of cure pointed out to us the advantages of some element of climate in the treatment of this prevalent disease. Long have we sought in differences of altitude and temperature and moisture for the key to these effects, while empiricism has dictated to us the advantages of this or

that locality as an agency of cure. Out of their fortunate experiences, physicians have learned to extol the virtues of the Adirondacks of New York, of the Blue Mountains of North Carolina, of the forests of Ontario and New Hampshire, of the high altitudes of Colorado and New Mexico, of the dry sand-swept plains of Arizona where decomposition is merely dessication, of the warm, dry air of Texas and California, and even of the cold, dry air of Minnesota.

But only now, as the International Tuberculosis Congress of Berlin declared, are we learning that but two prime factors enter into the qualities of all these favorable regions, but two elements are essential in their curative or preventive qualities. These factors are purity and dryness of atmosphere, in whatever latitude, at whatever altitude, on plain or mountain, in forest or on ranch. The conclusion is a simple, but potent one. It means a new emphasis upon the pernicious influences of the over-crowded quarters of our great cities. It means the necessity for a new development of suburban dwellings for the poor. It means the essential isolation of consumptives who pollute the atmosphere their neighbors breathe. It means a desirable reversion from urban to rural life. It means the establishment of sanatoria which shall afford sufficient cubic space for the diminished cubic area of tuberculous lungs. It means—it should mean—the segregation of lands in large tracts where these ideal qualities of atmosphere exist, where these qualities can be preserved and where they can be utilized for the conservation of the health of those who are well and the restoration of those who are diseased. It is not remarkable that the cities of California and Texas are beginning to blacklist consumptives. It is time they did. A quarantine against tuberculosis in our towns should be as effective as a quarantine against Yellow Jack.

The aggregation of disease-germs is dangerous anywhere, even though the atmospheric qualities of a given locality may be unfavorable to their development. Mass the tubercle bacillus anywhere and it will, sooner or later, work its destroying way. Disease-germs should be subjected to atmospheric dilution. Give them sufficient cubic area of pure, dry air and their most effective cultures will die out as they do in the laboratories of Minnesota. Put the tuberculous patient into the vastnesses of the pine forests of our Northwest and his cultures of the bacillus may not thrive.

New York has learned the lesson, and learned it expensively late, in the reservation of the Adirondacks. Ontario has learned it in the segregation of the Algonquin Park. Minnesota is trying to put that lesson into practice by the enterprising initiative of her medical profession, by the public-spirited aid of her associated women's organiza-

tions, by the assistance of her nature-loving friends in other states—in her effort to secure the creation of a great National Park in her pine forests and among the multitudinous lakes of the North. The health idea inspired and stands back of this project. To make this last great tract of native pine forest a national health resort, a natural sanitorium, is the primary and the most urgent argument for its segregation.

Other arguments obtain. In fact, no single public project carries with it more variant and cogent reasons for its success. Forest reservation is an economic necessity. The ruthless axe of the lumberman and the fire which follows in his destroying footsteps have well nigh removed from the face of this continent its vast areas of native trees. Forest culture has demonstrated its paying quality in European states. An object lesson in this science is needed in America. The forests of these Minnesota reservations can be made more profitable by tree culture than by agriculture.

The conservation of the Mississippi water supply in the matter of quality and distribution is a motive. The great natural sponge which the soil of the native forests forms acts, at one and the same time, as a vast filter and a vast reservoir. The artificial reservoirs which the government has constructed at the headwaters of the Mississippi at an expenditure of millions of money, are less effective by far in the control of freshets and the distribution of the waters of the great valley than this native forest sponge.

The preservation of the indigenous game of this game-stocked region is a secondary reason. No more delightful sportsman's paradise can anywhere be found than its woods and lakes afford.

The salvation to posterity of this great park is another and a nobler motive. The lover of nature needs but to see the beauties of these primeval pines and of these great inland lakes to feel that their final destruction would be a permanent loss to the higher life of the people.

But of more momentous consequence, of greater economic weight is the argument for the segregation of this area for sanitary purposes. Its opportunities are in therapeutic demand. The value of human life, not merely to the individual who possesses it, but to the state, far outreaches any measure of material wealth. The nature treatment of tuberculosis in this available region will repay the nation in men more than it can gain in timber by its destruction or in navigation its saving.

The sanitarians of this continent may exercise a large influence in determining the balance of public opinion in favor of the creation of the Minnesota Park. The American Public Health Association has already recorded its approval of the project. It should lend the weight of the personal influence of its members to the accomplishment of this end.

But while the question of climate, the quality of pure dry air, to be attained best by the preservation of such vast tracks of favorably conditioned land, is a large one in the nature treatment of tuberculosis, it is not the only significant one.

The medical world is indebted to Dr. Walther of Nordrach, in the Black Forest of Germany, for an object lesson in this nature treatment, for a demonstration of the results of a judicious combination, with favorable climate, of other important hygienic conditions.

The principle of as nearly physiologic rest as may be attained is of major importance. The influence of this factor in the treatment of tuberculosis was of common observation in the confinement of patients undergoing treatment, some years ago, with Koch's lymph. Hyperpyrexia is an invariable indication for complete repose. After its subsidence, the principle of carefully graduated exercise is of moment. By this method, the powers of the patient are systematically developed until they will endure sustained labor or excursions of from five miles to ten miles on foot.

And, finally, the principle of forced feeding, as to quantity, with due respect to the physiologic intervals of digestive repose, is a factor in the method. The gradual but material increase of food supplies is well endured, even in advanced cases and appears to go far in advancing the nutritive conditions of the tissues. If recent investigations into the relations of the leucocytes as primary agents in food absorption and elaboration give us a safe guide to follow, we may be the better able to understand how forced feeding enhances their phagocytic power.

This in a few words, covers the essential principles of what is fitly termed—The Nature Treatment of Tuberculosis. If, in severalty, its facts are not new, in their association they are of added weight and larger hope for the control of this most prevalent and destructive of the diseases of civilization.

REPORT ON THE PROCEEDINGS OF THE INTERNATIONAL CONGRESS FOR THE CONSIDERATION OF THE BEST METHODS OF CHECKING OR CURING TUBERCULOSIS.—HELD IN BERLIN MAY 24-27, 1899.

By E. A. de SCHWEINITZ, M. D.,

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As I had the honor of representing the American Public Health Association at the International Congress for the consideration of the best methods for checking and curing tuberculosis, held in Berlin, May 24-27, 1899, a brief report of some of the more important work may be of interest for record.

Her Majesty, the Empress of Germany, was Patroness of the Congress, and the Imperial Chancellor, Prince Hohlenlohe-Schillingsfürst, was the Honorary President.

The Honorary Executive Committee was composed of their Excellencies Count Posadowsky-Wehner, the Secretary of the Interior of the German Empire; Count von Lerchenfeld-Köfering; Dr. D. Bosse, Minister of State and Minister of Education, and General von Coler, Surgeon General of the Army. The Duke of Ratibor, President; Prof. von Leyden, Vice President; Privy Councillor von Mendelsohn-Bartholdi, Treasurer; and General Secretary, Dr. Pannwitz, constituted the Organization Committee.

The Red Cross Society, which encouraged the movement for calling this Congress and which has rendered invaluable aid to the tuberculous in Germany, was represented by the Chairman of the Central Committee of the Red Cross and many of the prominent members of this Society. Great interest also was shown by the women who were assiduous in making the Congress a success, and were attentive listeners to the discussions.

The meetings of the Congress were held in the Reichstag building, permission for the use of which had been granted, as the Reichstag had adjourned for the Whitsuntide holidays.[1]

At 11 a. m. on May 24th the Congress was opened in the presence of Her Majesty the Empress of Germany and her attendants, their Excellencies before named, and many of the most prominent of the German nobility, professors of universities, hygienists and many other interested members and delegates.

[1] This concession of the German Senate Chamber and the personal interest shown by the Emperor and the German Government in the Congress deserve special note.

There were more than 2,000 members of the Congress and about 225 delegates sent by 25 foreign countries and the different provinces of the German Empire. The United States, Belgium, Canada, England, France, Denmark, Guatemala, Japan, Italy, Mexico, Monaco, Montenegro, Nicaragua, Holland, Austria, Hungary, Persia, Portugal, Russia, Norway and Sweden, Switzerland, Servia and Spain were the principal countries represented. The fact that many of these countries had sent some of their most prominent men as Brouardel, Landouzy, Metchnikoff, Nocard from France, Weber and Stewart from England, as delegates, was evidence that this Congress was regarded by the civilized world as one of far reaching importance.

A large number of the members were laymen, as one object of the Congress was to interest all classes and professions in the important subjects under discussion.

The papers were considered under five different heads:

The Distribution of Tuberculosis.
The Causes of Tuberculosis.
The Different Methods of Guarding Against Tuberculosis.
The Various Methods of Treating Tuberculosis.
Sanitariums for the Care of the Tuberculous.

The first paper presented to the Congress, read by the President of the German Health Office, contained a review of the distribution of tuberculosis in Europe. In accordance with his well-prepared tables and statistics the percentage of loss from tuberculosis at the present time, as compiled from the most complete data available for Europe, are as follows:

Country	Deaths per million of population
Russia	3,986
Austria	3,625
Hungary	3,184
France	3,023
Sweden	2,310
German Empire	2,245
Switzerland	2,031
Ireland	2,029
Denmark	1,912
Netherlands	1,884
Italy	1,871
Belgium	1,767
Norway	1,737
Scotland	1,727
England	1,358*

* Available statistics for the United States indicate a slightly lower death-rate than in any of the countries which would be expected on account of its greater extent of territory and less dense population.

While no particular new facts were brought forward the comprehensive reviews of our present knowledge of tuberculosis were very complete and will serve as an excellent basis for further work.

Some of the conclusions of Prof. Frænkel, Prof. Lœffler and others were as follows:

Men and animals in which tubercle bacilli are found are the source of infection for others. While the tubercle bacilli outside of the animal body are easily destroyed when they become dry and are subjected to the action of light, nevertheless, infection takes place very readily in families, amongst people who live, work and sleep in close and ill-ventilated rooms, or are associated in any way whatsoever with others who are affected with tuberculosis. This infection may take place either through the skin, the mucous membrane, the digestive tract after the consumption of infected milk, butter or meat, or through the lungs. The last locality is most readily infected by the inhalation of dust containing tubercle bacilli, or by the accidental coughing, sneezing, etc., of tuberculous individuals in the presence of those non-infected.

According to Prof. Virchow, the noted pathologist, no sure data have as yet been adduced which show that tuberculosis is inherited. It is well known that other diseases of the respiratory organs and a weak condition of the individual furnish suitable conditions for the development of tubercle bacilli. In all probability, every case of supposed inherited tuberculosis could be traced to a direct infection after birth.

The views of Prof, Bollinger of Munich and other noted authorities agree with those held all over the world, by those conversant with the subject, as regards the dangers of contracting tuberculosis directly or indirectly from domesticated animals.

Milk for consumption should only be used from such animals as usually furnish the milk supply, as cows, goats, etc., after these animals have been submitted to the tuberculin test and have been proved to be free from the disease, and the sale of milk from such animals as have not been submitted to the tuberculin test should either be forbidden by law, or it should only be sold after thorough sterilization. It is well known that milk from cows that have generalized and udder tuberculosis, and also often from cows which have only local tuberculosis, may be infected, and the continuous use of uncooked milk from such animals is especially dangerous for children and young people. The fact that tuberculosis is found so often in swine as well as in men, that have been fed upon the milk from tuberculous cattle, is very good evidence that the disease may be so contracted. The wide distribution of tuberculosis amongst children and the localization of the disease in many cases, is an indication of infection by the use of milk.

If freedom from tuberculosis has once been established in a herd of cattle every effort should be used to keep the ainmals under the most hygienic surroundings, and no new animals should be introduced into the herd until they have been carefully examined and passed the tuberculin test. The increase of tuberculosis amongst animals is not only a menace to other animals but also to man. Tuberculosis of cattle and pigs is undoubtedly identical with tuberculosis in man. That the bacilli may undergo certain variations in appearance and virulence, depending upon their surroundings, is well known, but the careful work of Nocard has demonstrated very clearly that the tuberculosis germs in a comparatively short time become accustomed to their surroundings and increase their virulence under changed conditions irrespective of the particular species of animal from which they were originally derived.

Infectiousness of meat from tuberculous animals can always be guarded against by avoiding the consumption of raw or half raw flesh. Referring to the methods of guarding against tuberculosis, the opinions expressed by the different authorities on the subject did not differ materially from those at present held. They served, however, to emphasize the importance of the following well-known precautions: As the danger of the wide distribution of tuberculosis depends to a great extent, as has already been noted, upon infected individuals living and working in close, ill-ventilated rooms with non-infected, or upon healthy children, especially school children, occupying the same room as those who are infected, the greatest care should always be used in making an early diagnosis of the disease, and isolating those who may serve as a source of infection for others. In order that this may be satisfactorily done it is necessary that town laws and police regulations should be carefully enforced. While those might in some instances appear as hardships, they are no greater hardships than those entailed by the enforcement of regulations to prevent the spread of diphtheria, scarlet fever, small-pox and other contagious diseases. A very careful inspection by hygienists of the dwellings, factories and schools and places where people are crowded together should be insisted upon, and workmen should be protected as far as possible when they are engaged in such employments as fill the air which they breathe with dust and dirt. Disinfection and the cleaning of public conveyances, especially of sleeping cars, should be carefully carried out.

The various papers presented to the Congress reporting results obtained by different methods of treating tuberculosis, where the individuals were confined to their homes, or where they were in sanitariums, indicated that, while no certain cure for tuberculosis had been found, the scientific experiments in the line of serum therapeutics promise

better results than any other, and may eventually lead to some thoroughly satisfactory method.

In the establishment of sanitariums for the tuberculous greater progress has been made in the German Empire than in any other country.

The satisfactory results first secured by Brehmer and others in the erection of sanitariums for the treatment of the tuberculous have shown so conclusively that better results may be secured by treating the tuberculous sick in sanitariums than in any other way that the question of the necessity and importance of sanitariums is practically settled. It is only necessary now to enlist the sympathies of the people at large in this line of work to secure the establishment of national and state sanitariums. According to a German law which has been enforced for a number of years, a very small tax is paid by each laborer and by his employer into what is called the fund for the care of the sick. In this way a large amount has been accumulated. The money can be utilized for the poor in sanitariums, and at the present time fifty sanitariums are completed or in the course of construction in the German Empire, in which especial care may be given to the tuberculous. The area of the German Empire is about equal to that of the State of Texas. Dr. Pannwitz, a surgeon of the German Army, who was the General Secretary of the Tuberculosis Congress held in Berlin, has devoted especial attention for some years to the selection of proper localities for the erection of sanitariums, and it is largely due to his activity that the Red Cross Society became interested in sanitariums for the tuberculous and that this important congress was held and thus indirectly that the Emperor and Empress of Germany and a large number of the most prominent people of the Empire have actively encouraged the movement for the general erection of sanitariums, a movement which has attracted the attention of the civilized world. A similar movement has been started in England, examples which should be followed by all other countries.

A disease which causes annually one-seventh of all the deaths in the world should lose many of its horrors when civilized nations are united against it.

The fact that in the present state of our knowledge of tuberculosis we are able to recognize its presence very much sooner than was possible fifteen years ago, and that we are able also as its cause is better understood to take greater precautions against it, accounts for the fact that there has been a decrease in the death-rate from this disease. This but emphasizes the necessity of continuing and increasing our vigilance and enforcing in every direction measures which will diminish and eventually perhaps exterminate this dread disease, not only

amongst men but also amongst animals. The results so far obtained are the strongest arguments in favor of continuing the crusade so satisfactorily begun.

The methods adopted in the German Empire of caring for the poorer classes of tuberculous individuals in sanitariums serve a double purpose. In the first place, if the people are brought to these sanitariums in time, the disease may often be arrested, and while living in the sanitariums they are of course very thoroughly instructed in the proper methods of caring for themselves and the best ways of avoiding the infection of others. They are able, therefore, when dismissed from the sanitariums, to instruct their families and neighbors in the proper hygienic measures which should be observed. While of course they do not at first thoroughly appreciate the importance of many things which they have learned, and forget some of them when they return to their homes, nevertheless they remember many important sanitary precautions, and in the course of a few years the younger generations should possess a better knowledge of hygienic measures than they could secure in any other way.

Large corporations and insurance companies have found it to their interests to provide sanitariums in which the tuberculous may receive early and proper care and instructions. The erection of sanitariums for the tuberculous of the agricultural classes has also been suggested and if properly managed could perhaps be carried out in such a way that those who are but slightly affected or are suffering from incipient stages of the disease might engage in light agricultural pursuits which would be both a benefit and pleasure to themselves, and prevent them from being or feeling a charge upon the community. Sanitariums for other classes and professions might also be erected with advantage, where the individuals while benefiting by the care and treatment which they would secure in sanitariums might also have the opportunity of engaging in their regular pursuits.

If the movement which has been started in Germany is encouraged, and if other countries follow a good example we can expect within the next few years results of far-reaching and practical importance.

After the conclusion of the Congress the delegates were given a special reception by the Emperor and Empress of Germany.

INSTRUCTIONS TO PERSONS SUFFERING FROM DISEASES OF THE CHEST, AND TO THEIR ATTENDANTS, AND FOR PREVENTING THE DIFFUSION OF SUCH DISEASES.

By Dr. EDUARDO LICÉAGA,

President Superior Board of Health, Mexico, Mex.

In order that the Board of Health of Mexico may aid in the struggle which is being waged throughout the world, against tuberculosis, it has adopted some measures which I desire to briefly present to you.

To this honorable assembly the following papers contain nothing new. I present them with the sole object of showing in what manner Mexico lends her hand to this humanitarian work. The papers are as follows:

First. Instructions to consumptives and to those persons who surround them.

Second. Instructions in order to prevent the propagation of tuberculosis.

Third. Letter to physicians, soliciting their co-operation in the struggle against tuberculosis.

This disease is caused by a microbe called "Koch's bacillus." This name is due to the famous physician, Robert Koch, who discovered the bacillus.

When this bacillus is inhaled by persons predisposed to the disease by heredity or by any other cause which has deteriorated their organism, it seeks shelter in the lungs, altering them by the formation of a small nodule or tubercle which contains the above mentioned bacillus.

Under favorable conditions the microbes multiply, lodging themselves in the lungs which they invade to a greater or less extent. The expectoration of persons, afflicted with this disease, is filled with Koch's bacilli. If the sputa fall on the ground, on the wall, on the carpets, hangings, furniture, wearing apparel, bedclothes or handkerchiefs, they become dried, and are thus reduced to dust, and in that condition the least movement of the wind raises them, scattering them in the atmosphere.

If a predisposed person inhales that atmosphere, he absorbs Koch's bacilli which produces in him the same disease.

Thus, a consumptive patient can infect a healthy person, who is predisposed, should the expectoration become dried and be scattered in the atmosphere.

This is the ordinary mode of contracting consumption, but a patient affected by it is not harmful to those who live with him, either by his breath, his touch or his perspiration, and so, it is possible to live many years near a consumptive without contracting his disease, provided however that the expectoration of the patient be collected in a spittoon which contains a liquid, which does not allow it to become dried, and if, when the patient coughs, he does not throw his saliva towards the face of a healthy person. The spittoons should be cleaned with boiling water and their contents should be put into the fire; or if this be not possible, they should be disinfected with one of the liquids concerning which mention will shortly be made, and they should be emptied at once into the water closet or sewer; they should never be thrown into the court-yards (patios) or into the stables (corrales) as there might be domestic animals there which, by swallowing such material, would become sick, and thereby be in their turn, new foci for the disease.

Summarizing: A patient, who is consumptive, is dangerous on account of his expectoration, but only when it becomes dried and scattered in the atmosphere, or if it be coughed into the face of a predisposed person.

If this desiccation and scattering of the sputum could be prevented, it is not then harmful.

As it is seen, the practical mode of preventing consumption, is to collect the expectoration in spittoons, which contain a liquid. The spittoons can be those commonly used, provided that the expectoration be not left on the surface, because in that case, it would become dried and be harmful. The spittoons should be so made as to allow of their thorough cleaning and disinfection.

It is necessary to have a sufficient number, so that the patient can find them in all the rooms of the house, should he be able to walk.

Should he keep his bed, he ought to be told to use a spittoon which can be washed easily, having a cover that hides the expectoration from view and which prevents flies from getting to it, as otherwise the latter would become infected with the germs which they could deposit in other places, even discharging them on the food.

A very handy spittoon for those who lie in bed is the one approved by the Board of Health of Hamburg and which consists of a glass vase, wholly smooth, enclosed in an enameled iron case with a lid. The vase can be removed for cleaning and disinfecting purposes. The case itself can undergo the same process without its being altered.

Should the patient be able to leave the house and does not find a spittoon, he should take a portable one in his pocket. Many such are found in the market, of various materials and prices, adapted to the means of the patients. Those which are most highly recommended

are those of Dettweiler, Director of the Sanitarium at Galkstein, Germany. It is a small dark crystal vase, leveled, and which is closed on its upper part by a metallic lid, which is easily opened and closed. The expectoration is deposited directly in a funnel so that if the spittoon be accidentally upset, its contents cannot fall out. In order to facilitate cleanliness, the spittoon is closed on its lower part by a metallic piece, which is screwed on the glass; its cleaning is very easy and can be done thoroughly.

Another very useful and cheap pattern is the one made of Japanese paper. This spittoon, after it has been used, should be thrown into the fire.

To avoid expectorating on the ground a handkerchief made of Japanese paper, which should also be destroyed by fire after its use, may be used.

To expectorate on handkerchiefs is not to be recommended to consumptive patients because the expectoration so deposited can become dried and its dust scattered in the atmosphere, thus exposing the healthy persons who are predisposed to be infected. If the patient finds himself in need of expectorating in his handkerchief, on returning home, he ought to have it disinfected before delivering it to the laundry, and also to turn out the pocket of the garment wherein he carried said article, and have it also disinfected.

To summarize, we may say that a consumptive patient is not harmful unless he projects his expectoration into places where it can become dry.

Thus, the principal aim is to expectorate exclusively into the spittoons.

As seen, the recommendation urged upon the patients is nothing more than a law of urbanity and good breeding.

In order to prevent the patient himself from becoming re-infected with the dust of his expectoration, it is urged upon him to wash his hands whenever they are soiled with it. If he wears a moustache or beard, as experience has shown that simply washing is not sufficient to disinfect them satisfactorily, it is recommended to shave entirely. If by some accident his expectoration has fallen upon his wearing apparel or bed clothes, he should have them disinfected at once with the liquids to be shortly mentioned, before the same are sent to the laundry.

Those who attend the patient should take care to notify the Supreme Board of Health the very day when he vacates a house in order to have it disinfected before another person occupies it.

Any one who has fears of suffering from lung disease should consult at once his physician and have him examine him and his expectoration, so as to apprise him whether he is really affected with consumption.

Such a patient should know that his disease is curable provided he treats himself soon, if he follows the physician's advice, if he endeavors to avoid all disorders, if he remains alone in a room, well ventilated and which receives directly the rays of the sun, and if he has the energy and constancy in observing the treatment prescribed to him, because the curing of this disease is slow.

He should also know that his dried expectoration is not only harmful to other persons, but also to himself, should he continue to inhale an atmosphere where Koch's bacilli are scattered, and from the very expectoration which he himself projected. If his disease is well advanced, he will become worse by this infection; if he is convalescent, he will become sick anew, due to inhaling the air in which his expectoration has become dried.

The general rules of private hygiene are more urgent for a consumptive than any other kind of patient, but it needs be called to his attention in this place that the rules of hygiene are united with those of cleanliness and neatness in this case.

These last recommendations are given to those persons who have sufficient means to treat themselves in their own homes; but to those who are very poor, it is urged upon them to solicit admission to a hospital, because in those which the government proposes to complete soon, care has been taken that in them, as far as possible, shall be united all the conditions necessary, so that the patients may obtain a prompt cure of their disease.

Solutions for disinfecting spittoons:

I. Solution of Bicloride of Mercury.

Water	1 litre
Common Salt	20 grs.
Bicloride of Mercury	2 grs.
Aniline	1 miligram

This solution should be colored with aniline, and the bottle marked with a label, which should read: Solution of bicloride of mercury for washing spittoons. (Poisonous.)

II. Solution of Fenic Acid.

Water	1 litre
Fenic Acid	50 grs.

This solution would be revealed by its smell, and the bottle should contain a label which should read: Solution of fenic acid for washing spittoons. (Poisonous.)

INSTRUCTIONS IN ORDER TO PREVENT THE PROPAGATION OF TUBERCULOSIS.

The progress which medical science has made during the last few years having reached the point where it has been proven that tuberculosis is contagious, and the efforts which hygiene has notably made to avoid the transmission of that disease, would be of no avail if those under whose care and charge the patients are placed failed to impart their knowledge to the public, and if they did not assist the public authority in preventing the propagation of that disease.

Hospitals, be they public or private, sanitariums, whatever be their nomenclature, can lend their most efficacious aid in checking the propagation of tuberculosis. If these establishments would reserve a department entirely aloof for the use of the tuberculous patient, they would accomplish the first precept which hygiene teaches—the isolation of those afflicted with contagious diseases. If they would put in practice the "Instructions" concerning which we have been speaking, they would prevent the infection of those in charge of the patients; they would prevent the reinfection of the former and would put the same in such a state as to hope for the complete cure of their disease. Those establishments would lend a valuable service to the public administration if in their monthly reports which they send to the Supreme Board of Health, they would add the name, sex and age of the patient; also the address of the residence which he occupied before entering the hospital.

Directors of asylums, be they public or private, who have reason to suspect amongst the members of their wards, one suffering of tuberculosis, would lend a valuable service to the rest of the healthy members of their community, if they would have such a person examined by a physician. If the latter confirms the suspicion, the precautions recommended in the preceding "Instructions" should be taken with the patient. Heads of those establishments would equally lend a service to the administrative authority if they would enclose to the Supreme Board of Health the name, sex and age of the patient, and if it is possible, a note to the effect that such a person is subject to the regulations prescribed in the above mentioned "Instructions," or the impossibility of their being carried out, due to the peculiar circumstances of a determinate community.

Hotel proprietors, lodgers or boarding-house keepers can impede the propagation of tuberculosis by notifying the Supreme Board of Health, that one of their apartments has just been vacated by a patient so affected. The proprietors of those establishments ought to be the most interested parties in furnishing such data so as to have performed

the disinfection of the apartment vacated, for without such a precaution being taken, the comer or comers who will next or successively occupy said apartment, is or are liable to contract tuberculosis, and once this fact were known, their standard would be lowered.

Those who are in charge of the offices where medical consultations are held should likewise send notices as the above mentioned. There exists in Mexico the custom of establishing in some drug stores a room where free medical consultations are given to the poor. The proprietors of such establishments would contribute in diminishing the propagation of tuberculosis if they would remit the announcement referred to.

The physicians directly in charge of assisting these patients should strive to their utmost in this struggle against tuberculosis. Indeed, they are the true instructors of private hygiene. Their position in the inner circle of the family gives them authority which the councils of the Boards of Health can never hold. At the same time, the physicians, knowing the disease and the station in life of each family, are they who should advise their patients as to the conditions modern therapeutics have found to be most propitious for curing tuberculosis. They can recommend to the rich patient to place himself in one of the special sanatoriums which already exist for that purpose; to those who are not so well off and lack sufficient means to defray the expenses of those establishments but who can afford to live in the country—to these, they can recommend the best place in that locality where they should reside; to those whose spheres in life do not allow them to take lodgings in the healthiest part of the city or where the best hygienic conditions exist, they can nevertheless point out that consumption is less frequent where the population of the city is less dense. If even this cannot take place, they should select for the patient a room in the house which receives directly the rays of the sun, which can be most easily ventilated, and which, as far as possible, can be isolated from the rest of the house.

The physicians, on account of their knowledge, of their authority and of the habit which they have acquired of persuasion, are they who are destined to apprise the patients of their disease. They should select the moment, the opportunity and the manner of making this delicate confidence to them, and according to the circumstances, they should inform them of the "Instructions" published by the Board or should give them orally when the patient would be too much alarmed with a written copy.

The Superior Board of Health, in compliance with its duties, desires by all the means that are in its power to diminish the causes of mortality. To-day it has studied a series of measures destined to re-

duce the propagation of tuberculosis, and in order to put them into practice, it desires to count upon the most valuable aid of the whole medical corps, which by its character, and humanitarian views, is the natural agent of private hygiene.

The Board has decided to base on scientific knowledge the measures which it proposes to adopt in order that the authorities and the public in general, may not think that they have been decreed as empirical experiments. This is the reason why in this letter we will expound at some length the doctrine of tuberculosis, in its relation to hygiene, making from this point the formal announcement that it is not our purpose to teach to our colleagues any notion which might be unknown to them. Our sole purpose is to found our propositions, set forth at the end of this letter, and which would be lacking of a scientific sanction were they not based upon a knowledge which science has authorized.

Amongst the consequence which the influenza has brought along, which developed in this capital the very first weeks of the present year, there was observed a marked increase in the number of deaths, due to pulmonary tuberculosis. A careful investigation of the number of deaths caused by tuberculosis of the different organs, more especially by pulmonary consumption, shows that the mortality caused by this affection has increased in the city of Mexico.

As a matter of fact the general average of mortality occurring in a period of twenty-one years (1869 to 1899) was 7.5 per cent. of the whole mortality. The average of deaths caused by the same affections of tuberculosis was 9.31 per cent. during a period of eight years (1891 to 1898, inclusive.) The yearly average of deaths caused in these eight years, for all kinds of diseases from tuberculosis, was 1505, and of those from consumption alone, 1092.

These figures prove that the mortality from the affections named has increased; that the number of deaths caused by tuberculosis, make it imperative to procure by all means the reduction of such figures.

The labors of Villemin (from 1865 to 1869) proved, for the first time, that tuberculosis inoculates itself and that it is contagious. The discovery of Koch in 1882 came to confirm Villemin's ideas and to explain why it was contagious. Koch's discovery was confirmed by the physicians throughout the world, and this confirmation established beyond all doubt that the germ of tuberculosis is the same in all countries, whatever be their geographical position, and that the several manifestations of it, and even scrofula, is of the same origin.

Concerning the transcendental consequences of these discoveries, we are not going to dwell for the time being but on one, namely, that tuberculosis is contagious.

If consumption is caused by a microbe, it can be transmitted from a person affected with it to a healthy one. Observation and experiments have taught that the germ of tuberculosis is not able to attain its growth by the sole fact of its having penetrated into a healthy organism. It is indispensable in order to take root that the receiving organism be predisposed for its reception. In other terms, in order to prosper it is necessary, for the existence of this germ, that there be a proper medium for its development, in the same way that there is needed the existence of a seed, and of land, appropriate, in order that this seed should germinate.

Although it may seem trivial to make clear this last statement with an example, we are going to do so, solely for the purpose of giving more precision to our thought. For the proper development of a coffee plant, the existence of a coffee grain is not sufficient, but it is indispensable that there be suitable land in order for its germinating; if from two grains of the same plant, one is deposited in the fertile regions of the state of Veracruz, this will develop until it forms a large brush tree; if we sow the other on the arid plains of Apan, 2,200 meters above the level of the sea, this second grain will not live, or if it does, it will give place to a weakling plant, which will owe its existence solely to the great care put upon it.

The same takes place with Koch's bacillus; if we put it in an organism predisposed by heredity, which has reached, physiologically speaking, the lowest ebb, the germ will multiply and will produce tuberculosis, and the gravity of the case will be in proportion to the fertility of the organism invaded. But if we deposit Koch's bacillus in a healthy and vigorous organism, the elements of defense which it possesses will destroy or will make it sterile, or will make it harmless for the organism.

Observation and experiments have proven that the germ of tuberculosis leaves the organism, according to the organ invaded, either by the expectoration, by the intestinal or by the urinary excretions, and in conditions perfectly defined, with the lacteous secretion.

Of these means of expulsion of the bacillus, the most frequent is that by expectoration, in virtue of that fact that consumption is the most common (of 1506 tuberculosis, 1092 were pulmonary.)

If expectoration falls on the ground, in furniture or in clothes it gets dry and is reduced to dust. This dust preserves the living microbes and the least movement of the air will scatter them into the atmosphere. If a predisposed person absorbs the dust laden with Koch's bacilli, he is liable to contract tuberculosis.

The dry products of expectoration from tuberculosis patients is the only means capable of producing the disease. We cannot resist from reciting the experiences of Cornet:

The proof of the dissemination of the germs of tuberculosis was made by the author referred to in 1888. By gathering the dust scattered in furniture and the walls of the residences of consumptive people in such places where these could not have soiled them by expectoration or touch. This dust was diluted in sterilized water and injected into the peritoneum of the rabbits of India. From another source, Cornet tried by the same manner dust of diverse origins, such as wards of hospitals, demented asylums, surgical rooms, departments of the city occupied by consumptives, front part of the houses at Berlin, etc. The inoculation was practiced upon 392 rabbits of India. A certain number of these animals remained healthy, others succumbed to peritonitis, septicemia and superations, provoked by diverse pathogenic microbes; about a third (128) presented tuberculosis lesions. The dust which made the animals to be ill was gathered from the places occupied by consumptives, who had not used a spittoon, for projecting their expectoration. By their virulous character dust can be put in this order, that from hospitals for consumptives and from those wards inhabited by patients of this disease, and secondly, that from the demented asylums. The dust from the street, that gathered from the well taken care of surgical departments or from private houses where there was no consumptive patient, gave negative results. Notwithstanding the most exaggerated cleanliness of the patient, notwithstanding the most favorable hygienic conditions, bacilli were found in dust of the departments where a patient had projected his expectorations on the floor and on his handkerchief; whilst those bacilli are not to be found in the dust of the most unclean departments, provided that the patient expectorate exclusively into a spittoon.

Krueger in the clinical wards Boon, Kastner in those of Munich have obtained identical results with those of Cornet.

These experiments proved that the danger of contracting consumption is that the expectoration should fall out of the spittoons, become dry and be mixed with the atmospheric air. If then the desication of the expectoration be avoided, by collecting it in spittoons which contain liquid; if these spittoons be disinfected and cleaned completely and if their contents be thrown with the disinfecting liquids directly into a cesspool or sewer, the expectoration of consumptives is not then dangerous.

These are then the foundation upon which lay the measures of prophylaxis against tuberculosis.

These measures have been adopted in all those countries which are foremost in civilization; these are the same which we beg our colleagues to accept and recommend to their patients; these are, in fine, those which the Supreme Board of Health has adopted, and which are

contained in the "Instructions to those persons who suffer lung troubles and to those who surround them," and concerning which we have the honor to enclose to you several copies.

If it were possible to obtain that consumptives would project their expectoration in places where they could not become dry, the goal of prophylaxis would be reached. In order to obtain it, it is indispensable that each consumptive should know what his ailment is, that the same is a menace to those persons who are near him as well as to himself. To apprise him of this confidence, in every case, the aid of the physician is necessary. He is the only one who has the needed authority for its accomplishment, a power which he derives from his experience and scientific knowledge, his position in the inner family circle with the power which he naturally holds over the patient. The physician, who knows the character of his client and that of his family, the degree of intellectual and social culture, is the proper one who can take advantage of the opportune moment in order to acquaint his patient with this delicate information. The physician needs of all this tact and ability, so as not to wound the susceptibility of the one who has confided to him the care of his health.

Our colleagues will understand, from what we have just said, that we do not consider it an easy task to make known to a consumptive the nature of his disease, but that, in spite of the difficulties attached, it is the only resource which has been found efficacious by all the sanitary corporations and all the scientific corps, in order to initiate the combat against tuberculosis. We would like to be able to reproduce here the eloquent and persuasive words which Grancher said, when he presented to the Academy of Medicine at Paris, the reasons which the commission appointed by the same academy had for proposing the prophylactic measures against consumption, but as all our colleagues must be acquainted with that admirable document, we abstain ourselves from reproducing it here.

The motives which till today have prevented the physicians and members of the families of consumptives in not acquainting the latter with the name of their disease, was the universal and accepted belief that tuberculosis is incurable. The contrary proposition is the one generally accepted today; consumption is a curable disease.

Prof. Grancher, in a report of the Academy of Medicine, of whom we have lately spoken, thus expressing himself in relation to the prophylaxis of tuberculosis: "Tuberculosis is curable. It is much more so than was formerly believed. In a loud voice, it is necessary to say and proclaim that of all the chronic diseases, it is the most curable and the easiest to avoid, amongst them."

Founded on the words of such a respectable authority, we venture to propose to our colleagues that with the tact and delicacy with which they are wont to treat such subjects, they should reveal to their patients the disease with which they may be suffering, removing from them the old idea, that tuberculosis is incurable, and animating them so as to undertake with constancy and energy a treatment (always a long one) which the physician may advise. When the patient has persuaded himself that by projecting his expectoration outside of the spittoons, he is a menace to himself and those who surround him, the first step in the prophylaxis of tuberculosis will have been given.

But, as there will always be some patients who will expectorate outside a spittoon, those patients are so many foci for disseminating tuberculosis.

When a patient changes his apartments the vacant rooms should not be occupied till they have been disinfected. Here appears again the role of the physician as the guardian of hygiene, by notifying to the sanitary authority that such a place has been lately occupied by a consumptive.

In the transmissible diseases specified in the sanitary code, in those in which is required the announcement by the physician, the board of health receives in due time the notice, and so orders the apartment occupied by the patient, to be inspected, and to ascertain whether he has the means necessary so as to be conveniently attended in his own domicile or whether he should be removed to a hospital for his assistance. Consumption is not yet included in the code amongst the diseases which necessarily have to be reported, and this is the reason why we beg our colleagues to make of their own accord the notice with the restrictions of which we will shortly speak.

Consumption is a disease of slow progress, ordinarily insidious in its beginning, but its early diagnosis is necessary, as much for the patient's own good as well as for those who surround them; for the patient, because his disease will be more easily cured if he undertakes at the earliest possible epoch the treatment prescribed; for those who surround him, because the precautions set forth should begin from the moment the diagnosis has been made.

Science has lately been enriched with new resources which facilitate the early diagnosis of this disease, by the application of the X-rays, the reaction of the serum, etc.; the best means for confirming the diagnosis is the discovery of the bacillis of Koch in expectoration. All doctors take advantage of this to-day, some personally making the researches, others sending the expectoration for its examination to the numerous private laboratories, which exist in this capital. The Board of Health has solicited the permit for the establishment of special serv-

ice to be devoted to this investigation, in order to place it at the disposal of persons who are really poor.

Based on the above named considerations we are going to beg our fellow physicians to contribute to this humanitarian work of preventing tuberculosis in the following manner:

(1) By distributing the instructions referred to amongst the families.

(2) By recommending to the families of consumptives, who are under their charge, and by insisting especially that expectorations be projected into spittoons.

(3) By acquainting the patient of the true disease of which he is suffering at the time he may think to be most propitious.

(4) By notifying the Board of Health of the sex, age and domicile of the patients whom he may assist, afflicted with pulmonary tuberculosis, for which purpose they should use the postal cards which are to-day in vogue for making the announcements of transmissible diseases to be consigned to the Board of Health.

(5) By notifying in every case when they are attending a consumptive who may live at a school, asylum or in apartment house.

The object of this notice is to the effect that the sanitary authority may be in position to order a disinfection of the articles which might have been soiled with expectoration, as well as for the purpose of keeping an exact record of all the cases of tuberculosis existing in a town, in order to know whether the hygienic measures which have been advised give satisfactory results or do not.

The inspection visit which the board will make in the houses, has for its object the disinfection of the infected house. This disinfection having once been performed, there is no occasion for repeating it, unless the physician so requires, or at the vacancy of the tenant.

With regard to the clothing which will be soiled afterwards, the physician or the family will send it to the disinfecting station.

It may not be amiss to notice also that the visit of inspection, in order that the board may know concerning the sanitary conditions in which the patients may be found, can only be practiced by express order of the family or when the physician assisting the patient, and previously approved by the latter, is so expressed to the authority.

It is recommended to the physician that they should never omit to give notice when they may assist a patient with pulmonary tuberculosis in a college, asylum or in apartment house, because especially in the first two cases, these patients remain only a short time in those places, and it is of the highest importance to have the disinfection done as soon as the premises are vacated.

We trust that our fellow physicians will kindly receive these recommendations and will co-operate in this humanitarian work.

ELECTROZONE.

By HIBBERT WINSLOW HILL, M. D.,

Director of the Bacteriological Laboratory of the Boston Board of Health.

Mr. Chairman and Gentlemen—This disinfectant, Electrozone, is produced by the passage of an electric current through salt solutions or sea water, resulting in the formation of chlorinated soda, chlorinated lime or chlorinated magnesia, according to the solutions used, together with other substances. From sea water, mixtures of several such chlorinated bodies are produced, that of magnesia being most abundant.

The recently issued "Notes on Disinfectants and Disinfection," by Dr. Young, gives a very excellent review of the published investigations so far made. Most of the extended tests related to the action of Electrozone in purifying sewage, however. The writer, in 1898, undertook, at the instance of the Boston Board of Health, to investigate Electrozone suggested as a disinfectant for general municipal work.

Two different forms were examined. One was the product of a plant owned and operated by the Philadelphia Board of Health, the other was produced by the Woolf Manufacturing Company, of New York. The exact details of manufacture of the samples tested could not be obtained, but it became evident to the writer that the first of the solutions mentioned contained principally sodium or potassium salts, while the second contained principally calcium or magnesium salts, the natural inference being that the first was prepared by electrolysis of a sodium or potassium salt solution, the second from solutions containing calcium or magnesium.

For convenience we may designate these types as sodium-electrozone and calcium-electrozone respectively.

It became necessary then to make two sets of parallel determinations, one set comparing the sodium-electrozone with chlorinated soda solutions of the same chlorine strength and as nearly as possible of the same age; the other set comparing the calcium-electrozone with chlorinated lime solutions of the same chlorine strength and as nearly as possible of the same age.

The tests made related to:

1. Bactericidal action.

(*a*) Broth method; (Sternberg)
(*b*) Rod method; (Hill)

} In different strengths with different bacteria and with different lengths of exposure.

2. Physical and chemical action.

Turbidity, odor, available chlorine (volumetric), alkalinity (volumetric), keeping power; action on metals, dyes, fabrics, on albumens, fats, soaps; effect on the disinfectant of light, exposure to air.

3. Convenience in handling and in storage, applicability and cost.

The results of the tests justified the following conclusions:

Bactericidal action: The bactericidal action of all four solutions depend on their chlorine strength, so that in this regard, no one of them has any decided advantage over the others, provided that the chlorine strength is the same. The relative value of these four solutions must be decided therefore from considerations other than bactericidal.

Physical and chemical action: There was no practical difference in chemical properties between a solution of chlorinated soda and that form of Electrozone of equivalent strength which was sent to the laboratory from Philadelphia, nor between a solution of chlorinated lime and that form of equivalent strength sent to the laboratory from New York.

Convenience in handling, applicability and cost: Ordinary chloride of lime (chlorinated lime) and chlorinated soda, prepared by the U. S. P. formula, compared with either form of Electrozone, have one striking physical advantage, that of ease in handling. Electrozone is a liquid varying in strength, but usually equivalent in chlorine approximately to solutions of chlorinated lime containing from ¼ to 2½ per cent. of the powdered chloride of lime. Chloride of lime in powder practically may be regarded as a condensed Electrozone. The storage, transport and handling of Electrozone, as compared with chloride of lime in powder, is equivalent to the storage, transport and handling of a one per cent. solution of chloride of lime compared with chloride of lime in powder. Chlorinated soda may be readily prepared from chloride of lime and sodium carbonate. In the matter of convenience, then, the choice lies between a powder which can at any time be converted into a bulky solution and a bulky solution which can not at any time be reduced to a powder, under practical conditions. The available data shows the cost of manufacture of Electrozone to be greater than the cost of purchasing chloride of lime or of making chlorinated soda from chloride of lime by the U. S. P. formula. The recommendation to adopt Electrozone for municipal purposes is withheld, therefore, for two reasons—the greater cost and greater inconvenience of both electrolytic forms as compared with chlorinated lime or soda, the differences in other particulars being practically of no moment.

To sum up:

The hypochlorites of sodium and of calcium are excellent disinfectants, whether made by the ordinary chemical or by electrolytic methods, *provided that the chlorine strength is sufficiently high.*

A comparison of the sodium hypochlorites, whether made chemically or electrically, with the calcium hypochlorites, made chemically or electrically, reveals physical and chemical differences more marked than does a comparison of either solution chemically prepared with its electrolytic equivalent.

The results may be thus tabulated (it will be seen that the differences which exist depend entirely on the basic constituents and not on process of preparation).

Sodium Hypochlorite And Philadelphia Electrozone.	Calcium Hypochlorite And New York Electrozone.
Turbidity; Does not develop.	Turbidity; Develops on standing.
(atmospheric CO_2 forms soluble Na_2CO_3)	(from insoluble $CaCO_3$.)
Odor; Hypochlorous.	Odor; Ditto.
Alkalinity; high.	Alkalinity; Ditto.
Loses chlorine strength gradually by decomposition of the hypochlorite salts, setting free hypochlorous acid and chlorine.	Ditto.
Metals; corroded.	Metals; Ditto.
Dyes; decolorized.	Dyes; Ditto.
Fabrics; weakened or destroyed.	Fabrics; Ditto.
Albumens; *not* precipitated.	Albumens; *precipitated.*
(Chlorine strength is reduced by albumens however.)	Ditto.
Fats; converted into *soluble* soaps.	Fats; converted into *insoluble* soaps.
Soaps; unaffected.	Soaps; converted into *insoluble* soaps.
Light and air; reduces strength.	Ditto.
Heat; (boiling). Does not appreciably affect fresh solutions; old solutions lose strength rapidly on heating.	Heat; ditto.

Sodium hypochlorite has then three advantages over calcium hypochlorite: First, it does not become turbid on standing; second, it does not precipitate albumens; third, its sodium forms soluble compounds with fatty acids. On the other hand calcium hypochlorite is cheaper and somewhat more stable. The instability of both salts in solution has been somewhat exaggerated. For instance, one per cent. solutions of calcium hypochlorite have been found practically unchanged, as regards chlorine strength, after two weeks' exposure to the air in a dark place in wide-mouthed, unstoppered flasks. After that time, however, the loss of strength is rapid. If stoppered containers are used the loss is decidedly slower.

On the other hand, a solution of hypochlorites becomes more rapid in action as age increases, after a certain point, even with diminishing strength. This is due to the setting free of hypochlorous acid and chlorine as the salts slowly decompose, the acid and free chlorine both being more rapidly active than the hypochlorite salts.

It is not necessary to have an acid medium or to add acid to the with a satisfactorily short length of time for exposure. This is especially true of old solutions, provided always that the chlorine strength is maintained. To get very rapid action from fresh solutions, acids may be added, but it is simpler and cheaper to allow a longer time of exposure, since in any case the necessary exposure is a matter of minutes only, not of hours.

SIXTEEN YEARS EXPERIENCE IN FOOD AND DRUG INSPECTION.

By SAMUEL W. ABBOTT, M. D.,

Secretary of State Board of Health of Massachusetts.

Pure Food, pure air and pure water are three great conditions essential to healthy living.

The following brief sketch relates to the work of the State Board of Health of Massachusetts in the line of food and drug inspection for the period beginning with 1883 and extending to the present time.

Several investigations had been made in the early history of the board relative to this subject (see reports of 1872, 1873, 1879 and 1882), and it was found that a considerable amount of adulteration existed in the various articles used for human food.

A prize of $1,000 had been offered by the National Board of Trade in 1880 for the best essay upon the subject, to be accompanied with a draft of an act, as a guide to the necessary legislation.

The prize was awarded to Prof. G. W. Wigner, Secretary of the British Society of Public Analysts, and upon his draft of a bill, the law of Massachusetts was passed, substantially as it now stands. Several amendments have been made from time to time as experience has dictated.

For the first year under the operation of this law, the time was mainly spent in inspection of the food actually found, as offered for sale in the State, an appropriation of $3,000 for this purpose having been made.

The second year a severe attack was made upon the law by persons who feared that its operation might prove a hindrance to the dishonest speculator in impure food, and the war was carried into the legislature. But the honest farmer and grocer and druggist came to the rescue and the result was an additional appropriation making $5,000 for the second year's work. In the third year, the same tactics were again tried. Inflammatory circulars were issued by persons desirous of breaking down the bars and appealing to the fears of timid milkmen and druggists. The result was the same as before and the appropriation was doubled, making it $10,000 instead of $5,000. For the past four years the appropriation has been $11,500 annually.

With this amount it is possible to conduct a fair amount of inspection through the whole state. Under the provisions of the law three-fifths of the annual appropriation must be spent in enforcing the laws relating to milk and milk-products.

In addition to the general act of 1882 (which is much the same as that enacted in other states), we have several laws relating to special articles of food, and particularly in regard to milk.

Under these acts the Board has collected and examined in these sixteen years of work 97,590 specimens or samples of food and drugs[1] and has conducted about 1,400 prosecutions against offenders. The amount of fines turned into the treasuries of towns and counties has been $33,000. The total amount expended in carrying out the provisions of the law having been about $160,000 in the sixteen years.

The details of the work are to be found in the Annual Reports of the Board and are summarized in the following table (see next page):

Of the whole number of samples examined and included in the foregoing summary, 51,198 were samples of milk, 36,524 were other kinds of food and 9,868 were drugs, patent medicines, cosmetics and other articles of similar character.

More definite details in regard to these may be found in the Annual Reports of the Board.

One of the results of the early investigations of the Board was the proof that the adulterations in common use were mainly of a commercial and not of a harmful character. The staple articles of food, including the principal cereals, with sugar, and very many other useful and nutritious kinds of food are almost never adulterated, so that the actual ratio of adulteration is limited to a minor portion of the food supply.

The public is often lead to believe the contrary by means of alarming and sensational statements in the newspapers, such as have recently appeared, but actual inspection does not confirm these statements. For example, a recent statement circulated throughout the country affirmed that wheat flour was being largely adulterated, and in many instances by injurious substances. A collection of many samples of flour from different parts of the State was made by the inspectors, the result of which showed, on examination, that only five samples consisted of anything but pure wheat flour, and in these instances the addition consisted of a small quantity of corn meal.

The value of a food supply of a State, however, is so great as to warrant a continuous watch over its quality, since the few articles which are liable to adulteration are of sufficient consequence and value to require constant supervision to prevent the occurrence of fraud. New and ingenious methods of adulteration frequently make their appearance and demand the exercise of watchfulness on the part of the officials charged with the execution of the law.

[1] Or about 110,000 samples up to November 1, 1899.

FOOD AND DRUG INSPECTION—State Board of Health, Massachusetts. (1883-98).

SUMMARY	YEARS							
	1883	1884	1885	1886	1887	1888	1889	1890
Total examinations of food and drugs.....	1,298	5,644	4,778	4,326	5,420	5,766	5,454	5,985
Total examinations of good quality.....	720	1,210	2,751	2,649	3,563	4,019	3,716	4,096
Total exam. not conforming to the statutes..	578	1,434	2,027	1,677	1,857	1.747	1,738	1,889
Percentage of adulteration.....	44.5	54.2	42.7	38.7	34.3	30.3	31.9	31.5
Expense of collection, exam. and prosecution	$2,931.56	$5,529.60	$8,557.42	$8,025.34	$8,803.62	$8,915.41	$10,356.28	$10,013.04
Expense of col., exam. and pros., per sample.	2.26	2.09	1.79	1.85	1.62	1.54	1.89	1.67

FOOD AND DRUG INSPECTION.

SUMMARY	YEARS							
	1891	1892	1893	1994	1895	1896	1897	1898
Total examinations of foods and drugs.....	5,294	6,199	6,409	6,874	7,309	8,357	10,680	10,797
Total examinations of good quality.....	3,558	4,111	4,410	4,684	4,496	6,133	8,030	8,076
Total exam. not conforming to the statutes..	1,736	2,088	1,999	2,190	2,813	2,224	2,650	2,721
Percentage of adulteration.....	32.8	33.7	31.2	31.9	38.5	26.6	24.8	25.2
Expense of collection, exam. and rposecution.	$10,019.41	$11,180.30	$10,454.11	$10,364.64	$11,375.89	$10,921.61	$12,076.43	$11,062.68
Expense of col., exam. and pros., per sample.	1.89	1.80	1.63	1.52	1.56	1.23	1.13	1.02

TOTALS—Total examinations of food and drugs, 97,590. Total examinations of good quality, 66,222. Total examinations not conforming to the statutes, 31,368. Percentage of adulteration, 31.1. Expense of collection, examination and prosecution, $150,587.35. Expense of collection, examination and prosecution, for the sixteen years. Per sample, $1.54.

The actual cost of the food suply of the population may be determined approximately by observation among different classes of people. The Bureau of Labor Statistics of Massachusetts, in an article by Prof. W. O. Atwater (report of 1886, page 323), states the average cost of the daily ration, by observation of very many dietaries of persons of different occupations, at about twenty-five cents. This does not include luxuries, but the common forms of animal and vegetable food necessary for the support of life in a healthy condition.

The daily ration of seventy-five millions of people upon this basis would be worth $18,750,000 and the yearly cost $6,843,750,000. If only one-fourth of this amount represents the value of the articles which are liable to adulteration, the comparatively small sum which the different states annually appropriate for the work of careful inspection constitutes a good investment.

The articles most liable to adulteration are milk, butter, spices, coffee, syrups and molasses, cream of tartar, honey, vinegar, jellies and jams, olive oil and certain kinds of canned goods.

The milk supply of the State is one of the most valuable constituents of its general food supply. An expenditure of two cents each day per capita for milk amounts to an immense yearly sum when reckoned for the whole population.

In addition to the ordinary methods of milk adulteration, the addition of water, and the abstraction of cream, two other questions frequently present themselves in the course of the milk inspection of large cities and towns, the addition of coloring matter and the use of preservatives.

With reference to the propriety of treating the former of these subjects, the addition of coloring matter, as a distinct form of adulteration, in which the motive for its use is usually a fraudulent one, there can be little doubt; and the officials of the Board have been instructed to use every possible means to suppress the practice.

With reference to the use of preservatives in milk, the present statute (of Massachusetts) does not admit of any discretion, since any such addition constitutes "a foreign substance" under the provisions of Public Statutes (Mass.), chapter 57, section 5, and the later amendments of the same statutes.

The further question, whether additions of such preservatives as boracic acid, borax, bicarbonate of soda, salicylic acid, formaldehyde or other similar substances in such quantities only as may be required to preserve the milk for a period of twenty-four or forty-eight hours, are injurious to the health of the consumer, does not yet appear to have been definitely settled. The subject has recently been discussed with

renewed vigor in the British medical and sanitary journals without arriving at conclusions which may be deemed satisfactory.

If the use of such substances for the preservation of milk is to be permitted, it is plain that some definite quantitative limit should be fixed, an excess of which should be deemed a violation of statute.

In 1897 several amendments to the food acts of the State were made, some of greater and some of less importance, all of which had in view the protection of the general consumer and the prevention of special kinds of adulteration.

The following amendment to the general law of 1882 has had a wholesome effect, since it introduced certain provisions which had not hitherto been embraced in any statute.

Section 3, last paragraph of chapter 344, of the Acts of 1897, reads as follows:

> Provided, That the provisions of this act shall not apply to mixtures or compounds recognized as ordinary articles or ingredients of articles of food, if every package sold or offered for sale is distinctly labelled as a mixture or compound *with the name and per cent. of each ingredient therein*, and if such mixtures or compounds are not injurious to health.

The important amendment in the foregoing paragraph consists in the italicized words, which require the name and percentage of each ingredient in a mixture or compound to be distinctly placed upon each package.

The articles to which this applies, as found by the operation of the law during the past two years, are principally coffee preparations, or imitations of coffee, containing chicory and cereal products, spices, syrups, molasses and baking powders. Several complaints have been made and convictions secured under this provision, and have had a decided effect in securing a better condition of the market so far as the proper labelling of compound articles of food is concerned.

This question of the proper labeling of food products is one of considerable importance, as every one who has had occasion to administer food statutes very well knows. Many of the complaints which we have entered in court in the past few years, have rested upon the ground of fraudulent, or indistinct or insufficient labels.

The regular routine of work of the Board in the department of food comprises the collection of articles of food and drugs from all parts of the State by experienced inspectors and their examination by the analysts of the Board, with the preparation of cases for trial in court. In addition to this routine work the office is also open daily for the reception of such articles as may be brought in for examination. The articles of this character have not been numerous when compared with those which have been collected by the inspectors, but have represented nearly all classes of food. The examinations of this class have

also extended occasionally to articles which are not mentioned in the law, but are usually embraced very properly in the laws of other countries among the things which it is deemed proper for sanitary boards to examine, such as cooking utensils and articles intended for the conveyance and storage of drinking-water, wall paper and fabrics used for wearing apparel, children's toys and other articles in common use among the people.

The articles which were brought to the office for examination during the past year, and were not collected by the inspectors, are included in the following list:

Articles of food suspected of containing poisons, milk, spices, coffee, cream, molasses, confectionery, butter, maple syrup, flavoring extracts, flour, honey, diabetic flour, hair dyes, cosmetics and other proprietary medicines, whiskey, wine and cider, wax, wall paper and fabrics to be examined for arsenic, cooking utensils and toys.

The essentials necessary for carrying out a system of food and drug inspection are, *first*, a sufficient annual appropriation. *Second*, a well equipped laboratory, comprising the necessary apparatus and reagents for chemical analysis, and especially for the examination of milk. Microscopes for the examination of spices, coffee and other articles requiring ocular inspection. A small weighing-room and a room for polarizing apparatus. It is also convenient to add a closet for photographing purposes, in order to place on permanent record, some of the important forms of adulteration.

The officials necessary for the work are, *first*, a general director, who should be made responsible for the careful and thorough execution of the work of the department. All cases intended for prosecution should first be referred to him for consideration, and he should consider all cases of doubtful or disputed analysis. This person may or not be connected with a Health Board. In some of the States, as in Ohio and Connecticut, the work is intrusted by law to a single independent commission.

Second. An experienced food chemist or analyst. I use the term analyst as preferable since much of the work of food inspection belongs to the domain of physics or of microscopy rather than to that of chemistry.

This official should not only be an expert in his profession, but should have the qualities requisite for testifying with clearness and decision when upon the stand in court, in such terms as an ordinary jury or municipal judge may clearly comprehend. The chemist should receive the samples by number only, all labels, marks, brands or other indications of their sources or places of sale being removed before they are submitted to him.

Thirdly. The collector of samples. The duties of this official are necessarily complex.

Primarily, he has authority to travel throughout the States visiting the different cities and towns and to collect by purchase such articles, under proper supervision, as are most liable to adulteration. He should keep a vigilant eye upon the markets with a view to detecting the appearance of new and unexpected forms of fraud and adulteration, and should at once report any such matters to the general director.

While in order to be a good collector, it is not necessary that he should in any degree usurp the functions of the analyst or chemist, he should, nevertheless, possess the faculty of keen observation such as is essential to a successful detection, that is to say, he should use his five senses, those of sight, smell, taste and feeling, since by the employment of these powers in detecting the gross appearances of articles of food, half the work of food inspection is accomplished, before submitting the samples to the chemist.

He should also be familiar with the laws relating to food and should possess the requisite knowledge and skill to make complaints at court, to examine witnesses and prosecute cases before district and municipal judges.

The question will naturally be asked, What advantage is gained by the enactment of food laws and their excution, since enactment alone is of little use without enforcement? The real advantage gained cannot be exactly stated by means of figures representing pecuniary gain. The saving consists not so much in actual money returned to the pockets of the consumer as in an improvement in the quality of the articles purchased, and in the sense of security which is afforded by a well executed law.

That those States that have no such system of inspection have an inferior food supply so far as relates to articles liable to adulteration is susceptible of proof, since occasional inspections made in those States have shown this to be the case. There can, therefore, be no reasonable doubt that the system is well worthy of adoption in all communities. It is now in force in almost every large city on the Continent of Europe, as well as in Great Britain, and commends itself for general adoption everywhere, until the day shall come when man will no longer line his own pockets by defrauding his neighbor.

REPORT OF THE COMMITTEE ON A NATIONAL HOME FOR LEPERS IN THE UNITED STATES.

Your committee has to report as follows:

In October, 1889, the American Public Health Association, at its Brooklyn meeting, took action looking to the prevention of lepers landing upon our shores. The last Congress passed a law as follows:

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Supervising Surgeon-General of the Marine-Hospital Service, under the direction of the Secretary of the Treasury, shall appoint a commission of medical officers of theMarine-Hospital Service to investigate the origin and prevalence of leprosy in the United States, and to report upon what legislation is necessary for the prevention of the spread of this disease; the expenses of this investigation, not exceeding the sum of five thousand dollars, to be paid from the fund for preventing the spread of epidemic diseases."

The Ramsey County Medical Society (Minnesota), at its meeting in March, took action as follows:

"To the Honorable Senators and Representatives in Congress Assembled:

"In consideration of the fact that leprosy exists to a limited extent in the United States; that the dangers of importation of leprosy are on the increase; that the lepers themselves require more rational and humane treatment than is at present given them in this country; that the proper care of lepers by individual states is not practicable; therefore, be it

"Resolved, That the Ramsey County Medical Society of the State of Minnesota urge upon the United States Government the necessity of establishing homes or colonies where lepers can be segregated, thus protecting the general public and at the same time furnish these sufferers a comfortable home and suitable medical care.

"Respectfully submitted,

"(Signed.) "EDUARD BOECKMANN,
"Chairman."

The Minnesota Academy of Medicine, at its April meeting, took similar action.

In view of the fact that the Marine Hospital Service is required to investigate and report upon the prevalence of leprosy in the United States, and the necessary legislation for the prevention of the spread of this disease—such report to be made on or before December 1st, 1899—I would suggest that this committee be continued, to report at the next meeting of this Association. Respectfully,

H. B. HORLBECK,
C. P. WILKINSON,
H. M. BRACKEN.

THE LEPER HOME OF LOUISIANA.

By Dr. C. P. WILKINSON, New Orleans, La.

The Leper Home of Louisiana is situated on the Mississippi River and is distant from any other human habitation not less than half a mile. The entire grounds consist of a large plantation. The home proper consists of the various buildings attached thereto with extensive parks, yards, orchards, vegetable and flower gardens and is surrounded by a high fence to provide seclusion for the inmates, all of whom shrink from public gaze. An elevated platform under roof affords a pleasant place of repose for those patients who would look over this enclosure on that portion of the outer world presented by the passing back and forth of a number of steamboats plying up and down the river. This is the limit and only link connecting them with that existence which they have voluntarily abandoned.

The buildings at the home are measurably old, but in an excellent state of repair. They are the buildings usual on a southern plantation or large farm, and consequently are but little equipped with modern sanitary appliances, but as a home rather than a hospital is the purpose of the institution, little, if any, objection can be urged against them. The stewardship of the place is committed to the hands of a religious order "The Sisters of Charity." There is a visiting medical attendant and the whole is governed by a Board of Directors. The State makes an annual appropriation of money for assisting and maintaining the institution. The many charitable donate to it some funds and a quantity of clothing and supplies and a certain number of the inmates cultivate the gardens producing vegetables, while others address themselves to the care of the poultry yards, etc. Some cows, sheep and pigs are looked after in the outer fields by the employes. In this manner the institution is kept up with such comforts to the inmates as these means can supply. There is no fee or charge whatever to any inmate, but the few well to do see to it that compensation is given for their shelter. The present occupants of the home have come there voluntarily and are in all stages of the disease from almost the beginning until nearly the end. Every leper knows that Dantes inscription is written over the gates of the home and shrinks from entering this living tomb. Persuasion and appeals to both the selfish sense of greater comfort, and the nobler impulse of benefit to others have brought each halting footstep to this door. There is a state law directing that all lepers within the confines of the state shall be immured in this home. The district judges are given powers of commitment on the complaint of any two

responsible persons after due inquiry into the truth of the allegation; similar to the powers granted judges to interdict in cases of lunacy; but so far because of the care of relatives or the natural repugnance of men to imprison their fellows, or because no proper officer has been appointed to seek out and declare the law has never yet been called into action. There are supposed to be about 200 known lepers in Louisiana and of these only forty are in the home. So far medical treatment has not much to record in triumph in this institution or in other places. The patients soon after entering become reconciled to their lot and most of them find here such a haven of rest, such relief from that pain caused by the open aversion of their fellow-men, they become attached to the place and no power could drive them forth. While each inmate has his or her private bed, table linen and table utensils, etc., they mingle freely with each other in their occupations and amusements. Outdoor life is compulsory upon all; occupation and entertainment are the chief features of treatment. Those able to perform them are alotted tasks in farm life to which they quickly become attached and pursue with industry and interest. Education is a feature and the evenings are spent in games, music, recitation or readings. The one most valuable of all benefits to the leper in such an institution is the refuge he here reaches from the avoidance of his race; that aversion, which becomes more marked as the disease becomes more loathsome, inflicts many a pang, and an asylum from such reproach is a boon indeed. The congregation of a number of persons afflicted with a microbic disease of course increases the possibilities of infecting each other, and to this extent becomes an obstacle to successful efforts to cure individuals of the mass. This is the only objection that can be urged to the collection of lepers in a home. I believe the present knowledge of lamentable failure in the treatment of leprosy will discard this objection as being of little weight and not to be held as of any consideration in estimating the actual blessings such a home can confer upon the afflicted.

THE TREATMENT OF GARBAGE AND EXCRETA IN MILITARY CAMPS.

By BENJAMIN LEE, M. D.,

Secretary State Board of Health of Pennsylvania.

With one single exception all early religions have been demonolatries, the worship of devils. Their object has been to propitiate the wrath or malignity of the invisible power to whom the adoration was addressed. The worshiper did not expect to receive blessings so much as to avert calamities. The peculiar powers and possibilities for evil of the Gods of the heathen, therefore, afford an insight into the mental conceptions of the nations who celebrated their respective cults, as to what constituted the greatest evils to which they were liable and from which they desired to be delivered. With this thought in mind it is interesting to note that the most dreaded and most famous of the Gods of the early races whom we group under the name of Phœnicians, a people who had made great advances in science and art, and who were intimate students of the processes of nature, was Baal-Zeboul, the Lord of Flies, the Fly-Baal or Fly-God. The name of this demon is also sometimes written Beel-Zebub, or Dung-God. In view of the fact which modern research has demonstrated that several species of flies deposit their eggs in the dung of certain domestic animals, the connection of ideas existing between these two appelations is sufficiently clear. It is also worthy of note that in the story of the plagues of Egypt, the plague of flies which occurred in midsummer, when an immense amount of decomposing animal matter resulting from the destruction of frogs and other reptiles was putrefying under the rays of an Egyptian sun, was followed immediately by an epizoötic of great intensity and fatality, and that in turn by a wide-spread epidemic of a disease corresponding to the bubonic plague. So great was the veneration in which the Fly-God was held by the various nations of Palestine surrounding Judea that the Hebrews denominated him the "Prince of the Devils."

It is evident, therefore, that flies were early in the world's history regarded as a cause of disease, and that their presence in unusual numbers was held to presage pestilence and wholesale death. Like much of the wisdom of the ancients this belief became gradually obsolete, and has only been revived within recent years. The distinguished Professor Leidy, of the University of Pennsylvania, was probably the first in these later days, about the middle of this century, to call atten-

tion to the possibility of the transmission of contagion by the feet and proboscis of the common house fly. That which he regarded as probable from a theoretical point of view, has of recent years been made the subject of positive demonstration by numerous bacteriologists.

Dr. W. M. L. Coplin, Professor of Pathology and Bacteriology, Jefferson Medical College, Philadelphia, and Bacteriologist to the State Board of Health of Pennsylvania, read a paper before the meeting of the Pennsylvania State Medical Society, in May last, entitled, "The Propagation of Diseases by Means of Insects With Special Consideration of the Common Domestic Types," in which he mentions the following insects as having been shown by bacteriological tests to be carriers of contagion, either by becoming soiled with virulent pathogenic germs, or by taking the same into their systems and becoming, in that way, the hosts of parasites, namely: Flies, flees, bed-bugs, roaches, gnats and mosquitoes. The investigations made in the laboratories of the Jefferson Medical College Hospital have been principally confined to roaches, bed-bugs and house-flies. They show that, not only do the feet of these insects carry infection, but the entire ventral surface of the bed-bug and roach, and also the wing of the fly. The bacillus typhosus is that which has principally been made the subject of experimentation. It was demonstrated by culture as present until 96 hours after infection.

Dr. Coplin concludes that his experiments go to show that for at least from 24 to 48 hours, and it may be much longer, after infection, bed-bugs, roaches and flies may be potent agents in the transportation of bacteria.

There is no longer a particle of doubt that typhoid fever has been propagated in this manner. There are those who believe that a very considerable proportion of the cases of this disease which occurred in our army during the war with Spain originated in the contamination of the food of the soldiers with typhoid germs carried from the latrines by the spongy feet of these little pests. Certain it is that within an incredibly short time after the pitching of a camp, even in places where there was no reason to suspect contamination of the water-supply, typhoid inevitably made its appearance. Certain it is too that in the gross neglect of the proper construction and care of latrines and the promiscuous defecation which was practiced in many of the camps, especially those of volunteers, ample opportunity was afforded for such contamination. It has passed into a military axiom that "beans kill more soldiers than bullets." Had the great Napoleon, to whom this saying is attributed, been familiar with the modern discoveries in bacteriology, he would have modified his famous aphorism so that it should read "bugs kill more soldiers than bullets." Of the 5,731 American

soldiers who died in that war, only 454 perished as the result of wounds received in battle. Considerably more than nine-tenth died of diseases to a great degree preventable, and a large majority on our own soil without ever having heard the sound of the enemy's guns. Not typhoid alone, but also epidemic dysentery and camp diarrhœa may be attributed to the same cause.

Allowing the premise that the presence of flies in a camp is responsible for a share of the communicable disease which so constantly prevails, how shall we meet the evil? In three ways: First, by, as far as possible, banishing the flies; secondly, by, as far as possible, preventing the flies which we may not be able to banish from having access to garbage piles and latrines, and, thirdly, by protecting cooked food, milk and sugar as completely as possible from their visits.

First, then, How shall we banish the flies? By avoiding and destroying the nidus in which they propagate. With regard to the three most dangerous varieties we have definite knowledge in this respect. The common house-fly, the most dangerous of all, lays its eggs in horse manure; the horn-fly or cattle-fly in cow dung, and the blow-fly in putrescent animal matter. Hence, in selecting a site for a camp, the vicinity of stables, barns, barn-yards and recently manured fields should be sedulously avoided, as well as old camping grounds, where a certain amount of all of these materials may still be found. Neither horse manure nor cow dung should be allowed to accumulate in a camp for a single day. They should be removed to a distance and either burned or buried in trenches or ploughed under. In both of the latter methods of treatment they should be freely treated with quick lime. As a rule, farmers may be depended on to take them for fertilizing purposes, but they should be kept under close watch to see that they do not deposit their loads in the neighborhood of the camp. The garbage pit is a *nuisance per se* and, if unavoidable, should be placed as far as possible from the kitchen. Its surface should be covered with fresh earth and lime at least three times a day. Cremation is, however, the proper and only effective method of disposing of all such material. Wherever bricks and sheet-iron can be obtained a garbage furnace can be constructed with very little difficulty.

Learning that the Fifth Massachusetts Regiment, U. S. V., had supplied itself with a rough and ready garbage furnace, and that the results had been evident in the good health of the men, I wrote to my friend, Dr. Charles C. Foster, for many years the surgeon of the regiment, for information on this subject. His reply is as follows:

"My Dear Doctor—The furnace for burning swill that you ask about was a very simple affair, built by our own men, and not costing a five dollar bill. We dug into a steep bank, walled up the back and

sides with rough masonry, making mortar of the lime used as disinfectant, built a grate of iron bars near the bottom, covered the front and top with some heavy, second-hand sheet-iron, leaving a door and a skylight (with covers), adjusted an iron smoke pipe (second-hand) about one foot in diameter and ten or twelve high, and the thing was finished. When swill was brought from the kitchen it was first allowed to drain in a bin with holes bored in the bottom, then dropped through the skylight into the grating.

"It worked excellently, disposing of the swill of a whole regiment, and causing no nuisance. One corporal was in charge of it constantly, and the work was done by two or three guard-house prisoners.

At every company sink we kept a shovel, with which every man was obliged to cover his feces as soon as deposited—simply Moses' method up to date. In putting lime into the sinks I insisted that it should be thrown hard against the *backs* of the sinks; then as much more as necessary was sprinkled in.

"During the first three months, when the regiment was camped by itself, and I could thoroughly control matters, we had no deaths and only three cases of serious illness, all of which did well."

Portable garbage furnaces have been devised which can be made a part of every military train. The two blue prints to which I call your attention exhibit one and the same device, the larger is designed as a stationery furnace, the small, portable, for military purposes. The larger is shown simply as making the detail more easily understood. I may say that the United States Government has one of this kind now in use in the city of Havana, where General Ludlow is accomplishing such gratifying results in lowering the statistics of disease and mortality.

The portable furnace is constructed of steel lined with fire clay. Its weight is four tons—less than that of a heavy field piece or a siege gun. Three pair of mules can draw it. Its capacity for the destruction of garbage is five tons daily, and it can be relied on to destroy garbage, carcasses, when cut in pieces, and feces.

A stationary furnace of the same dimensions and similar construction is now in use for the purpose of disposing of cadavers and refuse at the Jefferson Medical College in Philadelphia.

In well wooded countries much offensive material can be destroyed by open fires. The lamented, though eccentric, Dr. Germer, the first President of the State Board of Health of Pennsylvania, was wont to say that the best of all disinfectants was "a can of kerosene and a match."

When it becomes necessary to handle large masses of putrescent animal matter, nothing will so quickly and effectively render them in-

offensive as bromine. Care is necessary in using this material, however, in consequence of the fact that it it very irritating to the air passages. If a camp is supplied with a dynamo for the purpose of electric lighting, this could be used during the daytime for the development of the solution of hypochlorites, known as electrozone, a most efficient deodorizer and antiseptic and a germicide of considerable value.

Formaldehyde, of course, suggests itself as a valuable agent for this purpose, at the same time it would probably be more expensive than either of the other articles mentioned.

Carcasses should always be burned, not buried. My experience at Johnstown, where it was necessary to dispose of large numbers of dead animals, was that they could be most readily and inoffensively consumed by covering them with rosin and building large fires over them. To throw a carcass into a stream is to commit the unpardonable sin. The deposit of either urine or feces in the neighborhood of tents at night should be severely punished. Buckets containing a disinfectant solution should be placed at accessible points during the night for the convenience of such as are disabled from visiting the latrines.

With all our care, however, we shall not succeed in entirely excluding flies from the camp. How may they be prevented from visiting the latrines and soiling their feet and bodies with poisonous excreta? This can be accomplished by a very simple expedient. Flies (unlike their liege lord, Baal-Zebub), notwithstanding that their deeds are evil, love light rather than darkness. Latrines should, therefore, always be covered with a tight shed which will exclude the light, not a leafy bower or white muslin enclosure. To make assurance doubly sure, all men suffering from bowel disturbance should be instructed to use buckets with a disinfectant solution, and in addition disinfectant solutions should be frequently distributed over the surface of the matter in the latrines.

Economy in the use of disinfectants is folly. The clause in the army medical regulations which forbids their use unless infectious disease be present, should be stricken out. It may be well enough from a purely theoretical standpoint, but its practical results are disastrous. The latrines should be always in such condition that the moment a disease germ reaches the surface it should be rendered harmless. The claim that the use of disinfectants discourages cleanliness cannot be considered, as it involves an admission of lack of discipline. The two should go hand in hand. "These things ye should do and not leave the other undone," should be the motto for camp hygiene. But whatever filth is to be deposited it should be preceded and accompanied and followed by the use of a disinfectant.

Having done our utmost to reduce the number of flies to a minimum, and to render those that remain innocuous, we should still endeavor to protect the food from their attacks. This can be accomplished to a very considerable extent by forbidding the troops from taking their meals to their tents, providing general mess tents, and covering all apertures to these with mosquito netting. This material is light and easy of transportation, and there is no reason why an ample supply of it should not form a portion of every camp outfit.

With the knowledge which we possess today of preventable diseases and the means for their prevention, it is not too much to demand that the disgraceful record of our camps of instruction during the Spanish war shall never be repeated.

WASTE DISPOSAL AND ITS ADVANCES.

MacDONOUGH CRAVEN. C. E., New York City.

In these papers I propose to treat only of the waste of the city, that would come under the disposition of the street cleaners, and those who are responsible for their efficient work, and will subdivide them as follows: Street-sweepings, Ashes, Household Waste, Factory and Trade Waste, Garbage, otherwise known as swill or slop, and Dead Animals.

In all instances, unless otherwise mentioned, the various classes and subdivisions given in this paper are taken from statistics of the wastes of the city of New York for 1898. This does not cover the entire city of Greater New York, but refers only to the boroughs of Manhattan and the Bronx, the population for which was given by the City Board of Health in June, 1898, as 2,048,820.

The collections in the city are made, first, by carts owned and operated by the Department of Street Cleaning. These carts collect only such wastes as are authorized by law, namely, street sweepings, household ashes and garbage. The other collections are made by so-called "permit carts," that is, carts holding permits from the Department of Street Cleaning or from the Board of Health, to collect such material as is authorized by law, but which the Department is not required to collect, and to deposit the same on the city's scows or such other places of deposit as may be designated.

In connection with the permit carts, many tradesmen and small manufacturers haul their waste material in their own vehicles and this material is received by the city which bears the expense of the final disposition. The permit cartmen are reimbursed by the people whose refuse is handled. They serve chiefly large hotels and apartment houses who desire to have a regular service, and they also serve the wealthier residents who can afford to pay and are also desirous of having regular service at set times.

The percentages given are percentages of the total amount handled by the Street Cleaning Department, unless otherwise noted.

The total amounts are taken from carefully kept records of material handled during the year 1898, and are subdivided as follows:

	Net Tons.	Cubic Yards.
Sweepings	305,800	395,000
Ashes	1,120,800	1,447,700
Rubbish	102,300	930,000
Garbage	170,300	310,500
Totals	1,699,200	3,083,200

STREET SWEEPINGS.

	Tons.	%
D. S. C. carts	262,900	15.4
Permit carts	52,900	3.1
	315,800	18.5

Samples of N. Y. City sweepings give:

Moisture	37.28 %
Organic matter	30.72 %
Ash	32.00 %
Phosphoric acid	0.35 %
Nitrogen	0.25 %

Stable manure gives:

Phosphoric acid	0.25 %
Potash	0.50 %
Nitrogen	0.50 %

Street sweepings are used for many different purposes. Primarily for filling in low lands; secondly, for manurial purposes. Recent investigations by the Department of Agriculture have shown that these wastes do not generally make an efficient fertilizer. If they are used in the making of compost heaps they will help very largely towards economical final disposition.

Sweepings, if dried, are found to contain about 50 per cent. of combustible refuse and 50 per cent. of inert matter that stands in the way of economical reductions of the sweepings by fire.

The analysis of sweepings taken from the asphalt paved streets of Berlin is as follows:

	Per cent.
Moisture	39.89
Ash	37.67
Organic matter	22.44
Total nitrogen	.479
Ammoniacal nitrogen	.004
Total Phosphoric acid (P_2O_5)	.452
Potash (K_2O)	1.891
Lime (CaO)	1.891
Magnesia	.347

(N. B. Taken from page 12 of the report of the Department of Agriculture, on "The Fertilizing Value of Street Sweepings.")

The cleanings of the catch basins and also of the street railway conduits are nothing more or less than street sweepings that have been washed, blown or swept into these various places of deposit.

ASHES.

*Coal (recoverable)	20 %
Clinker	15 %
Coarse ash and stone	15 %
Fine ash	50 %

	Tons.	%
D. S. C.	812,300	47.5
Permit	308,500	18.0
	1,120,800	65.5

* From N. Y. (Manhattan and Bronx) there could be recovered 150,000 net tons annually.

Ashes have at least 75 per cent. of inert matter, that is, fine ash and clinker, and are of two kinds. The house ashes that come from the residences and apartment houses and steam ashes that come from factories, hotels, office buildings and a few of the larger apartment houses.

Ashes from flat houses give—		Large house furnaces give—	
Coal	35 %	Coal	40 %
Clinker, slate and coarse ash	20 %	Clinker, etc	15 %
Fine ash	45 %	Fine ash	45 %

Household ashes (47.5 per cent.) have mixed with them more or less floor sweepings, and some paper and light rubbish. *Steam ashes* are practically clean, and having been wetted down after the cleaning of the fires and being more thoroughly burned than those that come from the kitchen stove or the furnace handled by the janitor, do not blow about and make less of a nuisance in handling.

Household ashes average in bulk and weight 45 per cent. of fine ash, 30 per cent. of clinker and coarse ash, and 25 per cent. combustible coal and coke. Some cart loads of ashes that have been sifted by hand in New York have shown over 45 per cent. of fuel, which has 75 per cent. of the full value of coal, and this fuel ranges in size from number one buskshot to the large size furnace coal. The fine ash has been previously proven to have a good value, if it can replace sand for mortar making; the coarse ash can be ground and mixed with the fine ash. Clinkers have a merchantable value and are used for concrete in sidewalks and cellars, and also make a very good road metal.

Pea coal from boilers—		Egg and nut from factories—	
Coal	20 %	Coal	25 %
Clinker, etc	40 %	Clinker, etc	30 %
Fine ash	40 %		45 %

Steam ashes (18 per cent.) being handled more systematically, are more thoroughly burned than house ashes, and do not contain as large a percentage of unburned fuel. But the quantity of recoverable coal which can be had from them, even when burned under a forced draft, would very much astonish the man who cleaned the fires. They have a certain value just as they come from the furnace, as they are used in the construction of fire-proof buildings. Many large buildings in New York take as high as five thousand cubic yards of ashes, and in many instances as much as 75 cents a load has been paid for them, and in a few instances the price has gone to $1.25. A large part of these ashes, however, are dumped on the scows, or used for filling in, because of the length of haul to the buildings, in the course of construction.

They are also used as road metal, but I do not believe them proper material for that use, as they will rapidly grind up, making a very dusty

road, unless some other proper material is judiciously mixed with them.

RUBBISH (excluding ashes.)

	Tons.	%
Household waste	88,300	5.2 %
Factory and trade waste	14,000	.8 %
Total	102,300	6. %

D. S. C.	88,300	5.2
(In ashes)	9,800	.6
Permit	4,200	.2
	1,023,600	6.0

Salable	35 %
Combustible	60 %
Non-combustible	5 %
	100 %
Ashes from combustible	17 %
Non-combustible	5 %
Total residuum	22 %

Rubbish comprises chiefly paper, rags, bottles, broken glass, china, tins and now and then when an old favorite piece of furniture is worn out it goes into the ash barrel or garbage can, whichever is the handiest. Six per cent. of the city's waste is made up of these materials, and a question of their disposal is at present one of the most interesting studies in connection with city waste. Col. W. F. Morse is to give you an exceedingly valuable paper on that subject. Briefly speaking, about 35 per cent. is salable, 5 per cent. unburnable and 60 per cent. furnishes an excellent fuel. All the waste selected by the rag-pickers or others properly authorized to handle these wastes can be sold at a very good price. Paper, rags, bottles, and metals are the chief constituents, but they are subdivided, depending on the demand for that subdivision.

Scrap rubber, for instance, is sometimes sold in bulk and sometimes graded as follows: New, good, poor, old, hose and mats, and rubber shoes.

HOUSEHOLD WASTE.

The composition of household waste is too well known to require particulars. I can say in connection with it, however, that there are two subdivisions to be mentioned, namely, ashes and rubbish. The household ashes make up about 50 per cent. of the entire waste handled by the Street Cleaning Department and the rubbish about 5 per cent.

Both household ashes and rubbish contain a larger amount of available waste, either for sale or for fuel, than the other wastes of the city. This is especially true when applied to the residential districts, although a fair proportion will come from apartment houses for the reason that there is no place to store any waste material, even if it is of general use.

FACTORY AND TRADE WASTE (excluding ashes.)

As handled by D. S. C.	14,000	0.8 %

This does not mean all of the trade waste as a large percentage of it goes directly to the manufacturers of other articles without passing through the hands of the city collectors. Foreign cities do not handle trade waste nor do all of our cities.

Factory and trade waste I have found to mean most anything. At one time I was requested to give a permit for the handling by the city of about 350 tons of beans that had spoiled in the hold of a vessel during shipment; this would have been a saving to the underwriters of about $120.00, but one of the underwriters being a tax-payer, believed that the city should carry off those spoiled beans, he classifying the cargo as garbage. In another instance I was requested to give a permit for the deposit on the city scows of over 450 cart loads of brick, mortar, plaster, etc., and our investigation found that an old house had been torn down, and a new one was being built, and the contractor thought that the city should take care of the old house. The fact of the matter was that the city did take care of a large part of it because the carts that were used were so badly out of repair that a large proportion of the old plaster and brick dust, sifted through the bottoms and through the joints of the side and end boards all over the street. Aside from this factory wastes take in metal clippings, straw, excelsior, wood scraps, shavings, sawdust, pickle refuse, floor and office sweepings, packing cases, barrels, and so on.

GARBAGE.

			Tons.	%
Moisture	70 %	D. S. C.	124,200	7.3
Grease (recoverable)	3 %	Permit	15,000	.9
Available (solids)	25 %	In ashes	31,100	1.8
Non-combustible	2 %		170,300	

AVERAGE ANALYSIS.

Water	65.90
Total solids	34.10
Nitrogen	0.86
Fat	7.07
Phos. Acid	0.07
Potash (K_2O)	0.03
Mineral matter	8.48

Garbage is a term that in many cases is used to designate all the waste of a city. In this paper it refers to the putrescible waste of the household, markets, food stores and such spoiled meat and other food products as are found necessary to remove from the city limit. It must be taken care of with as little delay as possible, and is, therefore, together with dead animals, the most important part of the street cleaner's work.

Garbage cannot be kept altogether free from a certain amount of rubbish which does not properly belong in the garbage can, any more than ashes can be kept altogether free from a certain amount of garbage; but the fact that practical separation is possible has been demonstrated by many of our large cities.

The last subdivision that I propose to deal with is that of

DEAD ANIMALS.

These, of course, are largely horses, and in many cities the cattle that have died in transport. Sheep, pigs, dogs and cats, are also included, although in some cases the smaller animals are carried off with the sweepings; this is not generally the case and ought never to be allowed.

In nearly every instance dead animals are a source of profit to the handler, and of small expense to the city. In one or two instances, the town or towns receive a slight return. The salable parts of the animals, such as the hides, hoofs, horns, tails and manes, are treated and generally sold to the manufacturer who makes a specialty of any one of the classes mentioned. The meat and bones are boiled down; the grease and oils extracted, and the bones and tankage turned into fertilizers, bone meal, or bone black, as may be most advantageous.

The above is the general method used in large cities. In many small towns the animals, if in good condition, are skinned, their hides cured, and the balance goes to the compost heap. It is well known that many animals unfit for work are slaughtered for food. This practice has not become general in the United States. In London dead animals are treated inside the city limits and large quantities of the meat are sold by the cats' meat men. The bones are boiled and bone black or bone meal made as required. The bones are sometimes used for knife and fork handles. Hides, hoofs, tails and manes, are treated as they are in this country. As far as Paris is concerned, I will quote you an extract from a letter that was obtained for me from an American visiting Paris:

"Your letter received about a week before we left Paris, and as I knew nothing about the subject you mentioned, I proceeded to interview private citizens, editors, cab drivers and policemen, and I am now able to give you the information you require.

"Small dead animals, such as dogs, cats, monkeys, etc., etc., are taken to the pound where a good many of them are sold to individuals who want the skins to make gloves, etc. Those that are not sold are cremated in a large furnace that they have for that purpose.

"Lost live dogs, cats, etc., are also taken to the pound and if not reclaimed in three days, are either sold or asphyxiated and treated as

those of the first part, i. e., sold for their skins or burned in the furnace.

"For horses, mules, donkeys and such, it is different. There are two or three different individuals who have made contracts with the city to remove any such carcasses when notified of its presence either in the street or in a private stable. They receive nothing for doing this from the city, but simply do it for what they can make out of it; but they are forced to remove the animal when called upon to do so. If the horse has been killed in an accident and is in good condition, the meat is sold to the butcher who sells horse meat to the poor people, but it must be labeled "horse meat." Their hides are tanned and used for leather; the fat boiled down to make grease for the railroads; hoofs used for glue, etc.; in fact, nothing is wasted. Mule meat is also sold, but they tell me that it is used more for making sausages than for steaks or chops.

"The pound belongs to the Department of the Prefect of Police, but the city has nothing to do with the horse and mule department, excepting to compel the entrepreneur to remove the carcasses and this department does not cost the city a cent.

"I hope that I have made all this clear and that it will be of service to you. It ought to be correct as I went to the Mayor's office and interviewed the policeman in charge."

In Vienna there is also a city institution built for the care of animals both living and dead that fall into the hands of the authorities. All live animals are quarantined and supervised in order to prevent them from being a means of distributing disease. They are moved from the quarantines or pounds, which are distributed through the city, at night at certain hours and along certain prescribed streets and taken to the final place of disposition, which is located in the suburbs. There these animals, if dead, are immediately taken in hand by the employes, and if living, are kept until such time as the authorities deem proper and then killed and utilized by the managers of this institution of final disposition. The managers are contractors who pay a rental to the city for the use of the works and reimburse themselves from the profits of this trade. All portions of the animal are utilized here as elsewhere.

REPORT OF PLAN PROPOSED FOR ADOPTION IN BRUSSELS.

The district commissioners have received from the third assistant secretary of state, Mr. T. W. Cridler, a copy of a report made to that department by the United States Consul at Brussels relative to the proposed adoption in Belgium of a system of disposing of dead animals. The minister of agriculture in Belgium proposes granting a contract for removing and destroying the carcasses of dead animals by a special process.

Inclosures for skinning and destroying the carcasses will be provided with a steam generator and an autoclave, or digesting furnace.

In the furnace the animal matter will be destroyed by steam heat at a high temperature, the furnace to be hermetically closed during the process. The gases generated are to be carried by means of pipes into the furnace of the generator, there they are to be completely burned and destroyed.

The products of incineration will not emit any pernicious odor after the operation. The resulting matters are stated to be very rich in phosphates, and it is proposed to sell them for fertilizing purposes. Carcasses infected with disease will be sterilized in special works authorized by the government.

GENERAL REMARKS.

Household wastes, although the most combustible of all classes mentioned have, notwithstanding, about 5 per cent. of uncombustible inert waste.

For *Factory and Trade waste* I have not been able to determine the amount of inert matter, but as far as inspection goes believe that they contain about 15 per cent. Garbage has 3 per cent. and contains also about 70 per cent. of moisture, and this must be evaporated or driven off or otherwise disposed of before the garbage can be reduced to ashes. In connection with this, several furnace makers claim the possibility of burning garbage alone without admixture of combustible. This, however, by actual experiment in one of the best, if not the best, furnace operation has been found impossible. Dead animals burn easily, and it is not difficult for any of you to see that the fatter the pig, the faster it will burn. In glancing over the above facts we can readily comprehend that as far as ease and economy of combustion is concerned, the furnaces would get along much better without street sweepings or garbage. Also if the garbage is mixed with the balance of the wastes of the city it contaminates all of those wastes, and street sweepings would probably do the same. Garbage makes up about 10 per cent. of the total waste of a city, and street sweepings will make 18.5 per cent. more, giving a total of 28.5 per cent., and if this 28.5 per cent. is kept separate and treated separately the other 71.5 per cent. can be disposed of almost as any one may see fit.

The fact of the matter is that garbage can be reduced for less than one dollar per ton, including transportation. This leaves the household rubbish uncontaminated and permits an income of at least (in New York) $90,000.00 from that alone, exclusive of the value of unsalable parts when used as fuel.

Ashes, if cleanly separated in the house, will permit of the recovery of at least 15 per cent. of coal, at a cost not exceeding one dollar per ton, selling for not less than $2.00 per ton.

Dead animals have always been treated separately, and there seems no reason why they should be mixed with the general refuse of the city. In fact, dead animals as well as garbage should be removed far from the center of population and they should be removed immediately or as near immediately as may be possible.

There are several perfectly safe ways of handling putrescible matter; one is by total destruction by fire; second, by utilization under various processes; and, third, is by utilization as manure.

Small towns can dispose of their garbage more cheaply and to greater advantage to themselves and others by building properly constructed compost heaps than by any other known method. By this means the plant food is restored to the soil as it should be. Total destruction of plant food should be prohibited by law. During the past ten years the plant food of this country could have been augmented from city wastes by 350,000 tons per annum at the value of $5.00 per ton, amounting to $1,650,000.00, and the money expended for producing this plant food and the grease which I have not heretofore mentioned, but which figures largely, would make the saving to the people much greater than I have attempted to demonstrate.

I say unhesitatingly that by either one or the other of the last two methods garbage and street sweepings can be turned into a fertilizer with no more danger to life and by creating no more nuisance than if they were cremated.

Compost heaps are simple of construction and inexpensive, and by the sale of the compost the expense to the municipality will be reduced. These heaps should not be too large; they should be built up in layers of proper materials, exposed on all sides to the air, and care should be taken not to build them too high, so as to prevent the too rapid heating which would take place provided there was sufficient compression.

The City of Geneva, New York, is one that is in the lead in this respect and will, if it continues to dispose of garbage in this manner, soon be able to give to the country information that will save towns and cities of from five to fifteen thousand inhabitants hundreds of dollars annually.

Let me suggest some of the savings in the above case: First, too rigid a separation is not necessary; second, the compost heaps can be so situated as to make the haul short; third, the necessary materials other than garbage can generally be had in the neighborhood at a small cost and the complete compost can be readily disposed of. Properly

constructed heaps would be inoffensive and no towns in this country are so situated that some land is not available for this purpose. By this process plant food is conserved and not destroyed.

I will now put before you a few of the reasons that make separation seem necessary:

Street sweepings are said by all authorities who have had anything to do with ther cremation to be exceedingly difficult to burn, not only on account of the moisture contained therein, but also on account of the inert matter, namely, sand which comes from the carts that convey it through our streets; that is sprinkled on the car tracks or on slippery streets to keep the wheels of the cars and the feet of the horses from slipping; also the gravel, broken stone and fine dust that are collected from streets that have been repaired or torn up for improvement or repairing. These items very largely enter into the composition that makes up street sweepings. Street sweepings, however, are exceedingly unhealthy, carrying as they do quantities of germs that are dangerous. These germs come from both men and animals and should be destroyed.

In larger towns of say from fifty to two hundred thousand inhabitants there are possibly many methods that are advantageous, but it is not right to say that the method that will prove most advantageous to Chicago would be, for the same reasons, the most advantageous to New Orleans, nor that the methods in vogue in London can be directly and advantageously applied to Capetown.

Methods in this country and abroad are widely different, for the reasons that the conditions are widely different and for these same reasons it is not always true that what is economical and satisfactory in one city will also be economical and satisfactory in the adjoining one. It would be well, therefore, if careful studies of conditions and necessities in each case were made by competent engineers, or at any rate by men whose experience in this line has been as far reaching as possible. It is a well known fact that many towns today are in want of means and methods of disposal. It is also well known that many cities and a few small towns are suffering because the means and methods which have been adopted have not proven satisfactory either to the city authorities or the population at large. In a few instances only has a thorough examination been made before a decision was arrived at.

Paris has published reports and papers by the engineers and other officials of the city for 1898 which cover in all 126 pages. In addition to this is also a report of the same character for the year 1899, covering 51 pages. Besides the above, two Commissions previously appointed had submitted extensive reports.

It seems, therefore, that the city of Paris had adopted a method of arriving at a proper conclusion that is in accord with the immensity of the work in hand. Four proposed methods were believed worthy of consideration and it was deemed advisable to try all four.

Berlin and Hamburg have also gone about their work in a way that will give good results of scientific examination. They experimented until they found what they believed to be the best.

New York studied the problem for nearly two years before adopting any method, and several commissions appointed by the past mayors had also given considerable time and made voluminous reports covering the entire subject.

It seems, therefore, that no city would be justified in adopting a method or methods without first having the subject thoroughly investigated by the proper authority. What city or town, for instance, would adopt a method of sewage disposal without first having the ground thoroughly covered by competent engineers, and without giving due consideration to what had already been done in other cities or towns under similar conditions and circumstances.

A few of the practical points that stand in the way of final disposition may be cited as follows: The length of time of a contract that a municipality can legally enter into. For instance, Chicago can make a contract for but one year and what firm will take a contract for a city of that size for one year at a price that will be acceptable to the city? In one year a firm making this contract must make money enough to pay for its plant, pay for its labor, pay interest on its bonds and for its experience. The bids will be necessarily high. If the length of time was extended to ten years, reasonable bids could be expected. In New York the time allowed is five years and it resulted in a fair contract. Had the time been ten years, however, the terms would have been more advantageous to the city. Another practical point is transportation; whether it be by water, rail, carts, or by any combination of the above. Locations we all know have a great deal to do with these matters and the class of material handled is something that should be investigated most thoroughly and its properties well known.

ADVANCES IN COLLECTION.

The various advances that have been made in the collection of wastes are slight. They are chiefly an increase in the size of wagons and the rapid loading and removal of the swill or other rubbish. The more rapidly the cart route is covered, the quicker it assumes a presentable appearance. Ash cans, garbage cans, and other refuse receptacles are quickly emptied and disappear to their proper places; but with the slow traveling cart the receptacles stand on the streets almost indefinitely.

Automobilism has been talked of, experimented with and theorized about for some little time, but all that has been put in actual practice or attempted has been done in England. I believe that it has large possibilities. An automobile six ton truck, with its attendant corps of handlers will traverse the streets rapidly and as soon as loaded, would save considerable time by making a rapid run to the point of unloading. The collection corps meanwhile could pave the way for another load or transfer their services to another automobile which would take up the work where the first one left off. The possibilities of rapid hauling of heavy loads by power cars are well worthy of consideration; or the transportation from central stations to the point of final disposition by power cars or street cars carrying heavy loads, while the shorter hauls or collections are made by the ordinary means of horse and cart.

As far as I have been able to learn "Chiswick" has put in operation a motor collection car, and the Horseless Vehicle Journal of January 15, 1898, refers to this as an accomplished fact, and furthermore states that the results in "Chiswick" are sufficient to demonstrate thoroughly the economy of the motor for this work.

There have been many improvements in the method of disposal at present in use, but the greatest advance that is known in this country is in the disposal of light refuse. I may say here that from all I have been able to learn from abroad America is in the lead. Work of a similar nature, however, is going on in several European cities. As a practical method this was first taken up in this country in New York, and George E. Waring, Jr., that fearless public official, that honest gentleman, that thorough engineer and sanitarian, to whom and through whom I owe all my present knowledge and my success in the past few years, was the man to start it.

Col. Waring first caused to be erected on some vacant lots on the middle west side of New York City a furnace for the destruction of the combustible waste, attached to which was a picking table, as it is called, which consists simply of a broad long belt on which the refuse is carried past the pickers, each picker selecting such material as is apportioned to him. The balance left on the belt is conveyed to the furnace and burned. The short experimental period established several facts: First, that a large proportion of the combustible waste was salable; second, that a large proportion not sold was reduced very much in bulk by passing through the furnace; third, that there was more than sufficient power produced than was necessary to operate the plant itself; and, fourth, and most important, was that this process could be carried on in the heart of the city without any attending nuisances of smoke or smell. These points once established, Col. Waring

determined to put in operation a still larger plant and this was done, the result being what is called at present the "Eighteenth Street Disposal Yard.' Here the work for the year 1898 gives the following:

	Pounds.	Tons.	%
Received at the yard	13,426,875	6713.4	100.
Sold	4,624,427	2312.2	34.44
Burned	8,114,321	4057.1	60.44
Consumed	5,842,301	2921.1	43.55
Ashes from furnace	2,272,020	1136.	16.92
Unconsumable	688,127	344.	5.13
Total resduum	2,960,147	1480.	22.04

The same style of furnace was erected and the same general work carried on as had been in operation at the experimental plant. The furnace used is practically a rectangular prism, 5 feet wide, 8 feet long and 17 feet high, inside measurements, containing three grates. The upper grate extends a little more than one-half way across the furnace, and has the widest space between its bars. The middle grate extends from the opposite side of the furnace underlapping by a few inches the upper grate. Both the upper and middle grates have a slight incline towards the middle of the furnace. The lower or third grate is level and covers the entire bottom of the furnace, and has the smallest distance between its bars. All the grates are made of tubes through which water is circulated. The waste material enters from the top. This is a down draft furnace; the hot air and gases after leaving the furnace pass through a tubular boiler and generate steam from the water that is already heated to a high degree in the tubular grates. This steam is used to operate the endless belt of the picking table, and a short belt conveying unsalable refuse to the furnace top; it also operates other machinery, such as blowing and exhaust fans and dust catchers (centrifugal.) The rubbish is dumped directly from the cart on to the belt, and as the belt carries it past the pickers the material is selected, thrown into barrels and then baled, bagged, crated, or after still further sorting, put up in such packages as the trade demands. This yard has been conducted now for about two years practically in the middle of the city and without complaint, except in one or two instances, where the contractor attempted to dispose of some yard sweepings by burning them in the open yard at night, instead of waiting until his machinery started in the morning, and putting them in the furnace. The method of conducting this yard is as follows: The city does the collection and delivery of the material at the yard; the contractor pays the city weekly for the privilege of overhauling and selecting the material and furnishes all the labor necessary; also all labor for operating the furnace. The form of this agreement and the

rate of payment have been changed from time to time, sometimes to the advantage of, and sometimes to the disadvantage of the city. As a whole, however, I can state that it is an unqualified success, the rubbish being reduced in bulk seven times. A slight change in the construction of the furnace would make this reduction in bulk more than seven (7) times and reduce it to 22 per cent. of its original weight. It is easy to see the saving to a community where they have only to dispose of one-eighth (1-8) of the original volume of rubbish and receive payment for the disposition of the other seven-eighths (7-8.)

DESTRUCTION.

The general improvement in furnaces during the past twenty years can be briefly sketched as follows:

One of the first was in operation in Leeds in October, 1877. In 1887 about twenty towns were using the destructors for various purposes. In 1897 seventy-five towns were operating destructors, and all of these that were doing satisfactory work were of the separate cell system. These cells being built in pairs or batteries, the number being determined according to the quantity of refuse to be destroyed. These cells are in a measure faulty in construction, inasmuch as they require considerable labor both for handling the material before it enters the furnace and in stoking thereafter. They do accomplish, however, the main point which is practically thorough destruction without nuisance in themselves.

The various points of interest and of real progress can be briefly summarized as follows:

First, the introduction of artificial draft; second, the abolishment of secondary fires; third, preventing of dust nuisances.

The introduction of artificial draft with its attendant high heats and slicing of fire is probably the more advantageous of the three things above mentioned. A forced draft of hot air seems to be the most efficient in cutting up the fires and in aiding the rapidity of combustion, but there is an increased cost in the labor attendant on its use. Steam jet induced draft, although it does not make as active a fire and although not so economical, mechanically, as the hot air (forced draft) does not require so much attention from the labor point of view, and seems to give more economical results than other methods. It is possible, however, that the furnaces using hot air (the best type of which is Beaman & Deas) are so constructed that an induced steam jet draft would not give such good results as it does in the Horsfall furnaces where this means of causing artificial draft is generally employed. These two furnaces are probably the best type of destructors

known for handling general refuse. The steam jet has claimed for it the following advantages:

First, that it keeps the grate bars cool, and, second, that it supplies vapor which in passing over and through the burning material is separated into water gas, supplying thereby a cheap additional fuel, which assists largely in the general process of destruction.

The claims made for the hot air method are that it assists largely in slicing or cutting up the fires and supplies oxygen in sufficient quantities for all needs and purposes, and also that it is less expensive to operate than the steam jet.

In the past few years a great deal of attention has been given to overcoming smoke and dust nuisances. The smoke nuisance carried with it, on account of incomplete combustion, serious objections in the way of disagreeable odors, and the dust nuisance was the resultant of large quantities of fine dust passing through the furnaces and up the stack to be distributed about the surrounding neighborhood. These nuisances have been overcome as follows:

Incomplete combustion, as has already been stated, by forced draft, and the dust nuisance either by enlarging or altering, in other ways, the actual working parts of the furnace, or by adding to the furnace proper a special form of construction to trap off the dust on its passage to the stack. Both methods have been used advantageously, and in certain instances the combination of the two has been found to give very good results.

All furnace operators find that mixed with certain of the materials delivered at the plant there is, sometimes in one case and sometimes in another, large percentages of non-combustible material, such as sand, earth, broken crockery, metal scrap, etc., that are not desirable from a fuel point of view, and in a number of instances attempts have been made to relieve the furnaces of this so-called unnecessary burden. Furnaces requiring a secondary fire to destroy fumes, are rapidly becoming obsolete.

UTILIZATION.

Utilization has also made rapid strides, and when we consider that it has been and is in operation in several of our principal cities uninterruptedly from the time of its first proper installation, it can be readily seen that it is a success. Its early history, like that of cremation, met with many disastrous results, and these primarily, because of the theoretical knowledge and deductions of the inventors and patentees of the various systems. These men claimed such great results that even at the present day it is difficult to make the general populace believe that the companies operating these processes are not making millions of dollars at the expense of the pocket-books and lives of the taxpayers.

At present, however, the methods in use have been brought to a practical basis and have been so greatly improved in mechanical appliances both of handling and the suppression and control of nuisances that the result seems to be that a proper utilization process once installed is there to stay. The advantages and disadvantages of this process have been so much discussed that it seems to me to be out of place in this paper, but its economies have never been questioned. There are instances, however, where the installation of a utilization plant would be ruinous in more ways than one, and as the practice now stands no town of less than 100,000 inhabitants at least can afford the reduction system. For any community numbering less than the above I can say that the question of installation of a reduction system would be an extravagance instead of an economy. On the other hand, in smaller towns it is very much of a question whether the only method that it left is destruction. As has been previously stated, compost heaps are cheap and not necessarily unhealthy. But to return to the progress in reduction methods.

All the reduction processes have advanced to a greater or less degree in keeping their material more under cover than formerly, but one of the greatest steps towards ridding these methods of their attendant nuisances has been effected in Boston, where a method of continuous pressing has been installed, which keeps all material clear of the floor and largely increases the rapidity of handling, and in addition to this there is installed also at this plant a method of ventilating the interior of the buildings and preventing the escape into the outer atmosphere of such noxious odors as may be generated within the confines of the factory and destroying these odors in such manner as to entirely do away with the objectionable features of this process.

Utilization, as practiced to-day, can be no more inveighed against, if properly conducted, than can total destruction. The other advances have been confined to the various subdivisions of the work, and result in much better classes of both grease and fertilizer.

I have endeavored to ascertain advances which have been claimed by other processes than the ones now working in Philadelphia, New York and Boston, but have met with little or no success, except from the process in operation in Buffalo. I am forced to conclude, therefore, that these other methods are at fault.

The improvements in the light rubbish disposition have already been spoken of. The improvements in collection are confined chiefly to the greater experience of the communities in which these collections

are made, and also the increased knowledge of the officer having the collection in charge, and the people are coming generally to see and understand that garbage (that is swill) cannot be collected too frequently, nor can it be too thoroughly protected in its receptacle from the time that it leaves the table until it reaches the collector's cart.

There is one method of collection and removal which is making rapid strides, and this can be briefly summed up in the general term of pick-up sweepers. It was my original intention to look into each and every one of these various sweepers and to touch on the important points that might be found in every machine, but the number of claims was so great, the number of sweepers so large, and the improvements claimed so many, that after visiting a few places where practical tests of various sweepers were in progress, and determining to my satisfaction that pick-up sweepers are coming to the front, I was forced to give this subject up, because of the time and expense necessary to go thoroughly into the matter. I found, however, in a general way, that the manufacturers of the various styles of these machines have come to the inventor's aid, and the combination of inventor and manufacturer is turning out in many instances a very satisfactory article. The chief points to be gained are simplicity of construction, lightness, quick and sure self-dumping, and easy construction. No machine as yet has been constructed that will pick up as much dirt as can be removed from the same street by hand sweeping, although in either case the method last on the ground will find considerable dirt left by the one preceding it.

CONTRACTS AND SPECIFICATIONS.

To the casual observer it would harly seem possible that many advances could be made on these lines other than reduction of prices, but as specifications improperly drawn expose both the contractor and the municipality to future difficulties and expenses, it is exceedingly necessary that an experienced hand should have the entire control of the drafting of these papers. This is especially so when one or more contracts in relation to the same general work are to be drawn.

During the past few years considerable care has been given to this work and the result has shown that too much care could not be taken. When these contracts and specifications were first drawn the subject was entirely a new one and so many things that were previously disregarded have shown themselves to be dangerous adversaries if overlooked that the drawing of specifications and contracts for work on this line is something that requires, if not the work, at least, the

advice of those who have had considerable experience. I can quote one instance which came under my notice. In the specifications it was said in regard to one class of material that it could not contain more than 10 per cent. by weight of garbage or rubbish. This clause permitted all the garbage and all the rubbish to be mixed with the ashes. It was faulty, not only in verbiage, but also in quantities and destroyed the entire meaning of the contract. It was necessary to find some excuse to decline the bids and new ones were immediately advertised for under a new set of specifications.

A closely built up city offers the best advantages to reduction systems for the following reasons: The garbage can be collected at comparatively small cost and the haul being also short, a vehicle can cover considerable ground and lift all garbage on its route every day. The quantities collected will be high when computed on a per capita basis, as there is no way to dispose of it on the householders' own property; when large quantities are collected a reduction system can be operated economically.

The scattered inhabitants outlying the center of the city generally have some means of disposing of a part of the household wastes on their own property. This, together with the extreme length of time that it is necessary for obtaining a cart load, makes the cost of collection high and for this reason collections are not made daily and the garbage collected is in a pretty bad condition. For these reasons the hauls should be short and a series of smaller places of disposal, other than the central plant, then become the most economical. It is hardly advisable to construct compost heaps on the outskirts of a large city, the resort, therefore, is cremation. Conditions as given above are the ones that have to be faced in New York, and with the result that the present conclusion is that utilization and cremation should go hand in hand. The necessary economies of a great city have forced this conclusion, and it has not been reached in the past few months either, but has been considered the best thing to do for some time past.

In Europe, after it was found necessary to develop such high temperatures as 2,000° F. in order to obtain thorough combustion and immunity from nuisance, the idea immediately presented itself, Why not use the waste heat? This has been done to a certain degree.

There are two things that militate in a greater or less degree against the general burning of mixed wastes—one is the expense attached to the processes themselves and the other is the amount of material in the shape of clinkers, ash, etc., that comes from the destructors. This last

in some instances runs as high as 60 per cent. The average is somewhat less.

A theoretical percentage of residuum from destructors of mixed refuse can be arrived at as follows:

SUBDIVISION OF 100 POUNDS EACH OF VARIOUS CITY WASTES.

Material	Inert Matter	Fuel	Salable	Moisture	Ash from Fuel
Ashes.....	75	25 (or salable material)			6
Rubbish.....	5	60	35		17
Sweepings.....	25	50		25	10
Garbage.....	2	28 (or salable material)		70	8
	107 lbs.	163 lbs.	35	95	41
	%26.75	%40.75	%8.75	%23.75	

107 lbs. of inert matter, plus
41 lbs. of ash from combustible

gives 148 lbs. of ash, or 37 % as the theoretical total ash, but the burning in a furnace at a temperature of 2200° gives a more complete combustion than in the furnaces that are in general use for coal and the percentage of residuum might be less than shown by the above figures.

THE NEXT STEP IN THE WORK OF REFUSE AND GARBAGE DISPOSAL.

By W. F. MORSE, S. E., New York.

The Report of the Committee on Garbage Disposal at the last meeting of this Association, contained conclusions formulated after an exhaustive survey of the present conditions here and abroad. Unfortunately, because of the lack of funds to defray the expense of publication, it was not accompanied by tabulated detailed information which would have added much to its value. The conclusions reached may be briefly stated as a basis for comparison in estimating the progress made in the year past, and are substantially as follows:

I. The reduction methods for garbage disposal are applicable only to large cities. It has been found impracticable to conduct the works so that a nuisance would be wholly prevented unless located at points where an occasional nuisance would not be objectionable. A number of works have been abandoned for sanitary or financial reasons. In many cases the reduction process does not dispose of all the offensive material, and therefore should be operated in conjunction with cremation.

II. When separation of the various waste materials cannot be made, there is but one way to satisfactorily accomplish final disposal—by cremation.

III. That garbage, refuse and ashes can be burned without additional fuel if means be taken to remove the fine ash, which chokes the fires.

IV. That the garbage in American cities contains more liquids in suspension than in Europe, but an additional amount of combustible material compensates for the moisture.

V. In view of the results as obtained in England and Germany, there appears to be no reason why the same methods of disposal, under the same limitations and conditions, should not be equally successful in this country.

The lapse of a year since the report was written has brought out some facts which are of interest, adding to our knowledge in several important particulars, and promising to be of service in the future.

The methods of reduction, or the conversion of garbage by mechanical or chemical process into commercial products, have not changed greatly.

The City of Boston brought into use a large and elaborately equipped plant for the daily conversion of 200 tons of separated garbage. The plant is operated by the same company that controls the work in Philadelphia and New York, and the garbage is taken from the city dumps in the scows of the company to the works, which are six miles down the harbor. The introduction of an improved system of presses provides for the continuous crushing of the garbage to extract the water and grease, under conditions which do not allow the escape of odors or offensive smells. A further provision has been made for a system of conveyors and transfers which receive and dispose of the garbage without loss of time, and without nuisance in the work.

The works in Philadelphia, operated by the same company, now in their fourth year of establishment, and carried on in the midst of a thickly settled community, appear to have been a most successful plant in respect to the elimination of odors and offensive smells. There can be no doubt but that the work of treating garbage by mechanical and chemical processes, when carried on under the improved modern conditions and in buildings suitably constructed and ventilated, can be conducted without offensive odors or fumes, when due care is taken in the work. The use of a system of ventilation conducting the odors into a stack or chimney where they are destroyed by heat, and the employment of proper disinfecting agencies for the treatment of garbage in its first stage, and the use of condensing apparatus which evaporates the water passing from the presses, and obtaining the ammonia and other chemical products, have together been productive of such beneficial results as to make it evident that the plants can be conducted in a way to avoid all sanitary nuisances of whatever kind.

In an inland city of New York, a new reduction plant has been established which is still upon trial and from which no reports are yet received. On the other hand, two reduction plants have been abandoned for sanitary and financial reasons, and in another large city the contract for the reduction of the garbage by this process was not renewed, but the city has advertised for cremating plants.

In considering the question of disposal by reduction as compared with cremation, we are forced to the conslusion that when a sufficient amount of garbage from a population of 150,000 people or upwards, can be satisfactorily separated from other substances and can be, by the best improved agencies, so treated, mechanically and chemically, as to be without nuisance in the process, and when the works can be situated at a point where an expensive haul is not necessary, then it is evident that reduction has a peculiar value, not only for its own purposes of obtaining grease and fertilizing material, but also for the reason that it is practically impossible to destroy separated garbage

by cremation when collected by itself, unless a considerable amount of fuel is employed.

We know from experience that ten tons of garbage can be destroyed by a ton of coal, and if, to the cost of the coal, is added the cost of the labor, it becomes, in localities where fuels are expensive, a very considerable burden. The question was put a very short time ago to an English engineer whose experiences had been very great in the matter of burning municipal waste abroad, if he could destroy the 350 or 400 tons of selected garbage then lying before him in a scow, without the employment of coal or fuel, and he unhesitatingly said it could be done. We must concede that under certain conditions the utilization process has not only a claim, but, so to speak, the right of way, as against other methods for the disposal of waste, and that, independent of the value to be derived from its mechanical treatment, some consideration should be paid to the argument that it is not only wise but emphatically a duty to restore to the ground in some form of fertilization the constituent parts which have been taken from it in the shape of vegetable substances.

On the other hand, the progress of cremation methods within the year has been steady, though slow. Several crematory furnaces have been built or are now being completed, and others are under contract.

There are now over one hundred cities and towns in the United States investigating, advertising, seeking information, and awaiting the advent of a thoroughly satisfactory and efficient apparatus or methods for the disposal of their waste. But it is a significant fact that, in the year past, none of the large cities have signed contracts for disposal, though many opportunities have been offered.

Chicago, Milwaukee, Louisville, Savannah, Atlanta, Albany, Binghampton, Manchester and many other places have asked for proposals —in some instances two or three times over—and received tenders for crematory furnaces and from companies especially organized to take up the work in various ways, but in each case the cities have declined to make awards.

There appears to be an unwillingness to accept the plans offered, and a distrust of the appliances or measures proposed, as being unsuitable for one or another reason.

In some cases the strong competition of rival furnace builders, and the flattering story of prospective gains to be reaped by garbage disposal companies, has lead to the employment of means and influences to obtain contracts that were to the disadvantage of the city, and the knowledge of this has reacted upon the contractors, defeating their purposes. In other instances the manifest inadequacy of the pro-

posed plan and apparatus to do the work, has met, as it deserved, with a decided rejection.

The chief points in which improvements of the present methods are to be made are:

A. The certainty of disposing of waste without creating a nuisance in the operation.

B. The reduction of the cost of cremating by employing the waste itself as fuel.

C. The separation, at small expense, of articles and substances found in municipal waste that have value, and are marketable.

D. The utilization of the surplus heat from burning waste for useful purposes.

A. *Primarily, the removal and destruction* of useless and offensive matter from the community for the public protection and public comfort, is the purpose and end of all our efforts. No consideration must be allowed to supercede or interfere with the sanitary side of this question; therefore, no reduction process or crematory furnace can ever be successful that does not give immunity from nuisance in performing its work. That it is entirely possible to destroy waste by fire, with no objectionable results, has been repeatedly proven by many examples; and it may be assumed at once, that, with the use of the best methods and apparatus, and continued attention, everything worthless, dangerous and offensive, produced by a town or city, can be burned without creating insanitary conditions. With this principle clearly defined and accomplished, all else is possible; without it nothing in this work can be of permanent value or service.

B. *Nearly every one of the cremating furnaces now in use,* destroy the garbage by main force, so to speak. They proceed by seperating the putrescible matters—placing this in large quantities in a furnace, and using fuel to consume it. But little attempt is made to utilize the combustible rubbish. This, as a rule, goes with the ashes to the dumps, and there creates trouble and annoyance.

Thus the cost of fuel becomes an important factor, and has often decided the question against cremation in localities where fuels are expensive. There has been a very considerable decrease in operating expenses since the beginning of this work, ten years ago, but this item can be brought still lower, or eliminated altogether, by bringing into use apparatus and means which latest experiments have shown to be successful.

It should be remembered that every ton of average separated garbage contains from 1,400 to 1,600 pounds of water that must be evaporated before combustion begins, and that the heat producing value of garbage, when burned in closed furnaces, is about one-tenth of an

equal amount of coal. But a preliminary drying-out of a charge of garbage and bringing it into a condition to burn, utilizes this one-tenth of the heat values, and makes the operation quicker and far more economical.

If, now, to this dried charge of garbage be added a proportional amount of dry refuse, there is a sufficient bulk of material to maintain combustion with little or no additional fuel; and this is precisely what is sought to accomplish in the latest type of the American furnace.

In this Improved Refuse and Garbage Destructor there is provided a drying chamber placed behind the front compartment, which receives the charge of saturated garbage. By dividing the lower longitudinal section of the furnace by a bridge-wall, it is possible to make the front compartment an enlarged fire-box, kept supplied with dry refuse, into which the charge of dried garbage is brought forward. The consumption of smoke is provided for by suitable combustion chambers divided by fire-brick lattice-work, which transforms all combustible elements into carbonic dioxide.

The results of the whole operation are to utilize the combustible refuse for fuel by drying and burning out successive charges of garbage, maintain the temperature, deliver the heat where most effectually employed, and thus, with no additional cost for labor, reduce the cost of operating to a rate far less than by former methods.

C. *The value of city rubbish or dry refuse* is just now becoming understood and appreciated. Nearly everything discarded from the household, if separated and properly handled, has a market value, and can be turned to some useful purpose. Within the past year a practical and satisfactory method of making this separation has been devised and put into use, and in two cities works have been established and are now operating.

The history and results reported from the Refuse Disposal Station of New York City will be the subject of another paper, and need not be here described. The construction, in another city, of a larger and more efficient plant devoted entirely to this work, is most significant as a sign of progress in the art of waste disposal, and as indicating what will be the future action on this question. What is now being done in New York and Boston can be done anywhere with equally good or better results.

THE BOSTON REFUSE DISPOSAL STATION.

In 1895, the Board of Health of the City of Boston recommended the erection of a furnace to destroy the combustible waste which was then dumped with the ashes at various points, or conveyed in scows down the harbor and thrown into the sea. The Board renewed this

recommendation in their reports of 1896-97, and in April, 1898, the city advertised for bids for the disposal of this waste by cremation, estimating the amount at 500 cubic yards, and stipulating that the work should be done at one of the dumping boards. The four bids received were rejected as unsatisfactory, but in the September following, plans were presented for a Refuse Disposal Station which were accepted, and subsequently a contract was made with a private company to carry out these plans by special contract.

The contract provided that the company should, at its own cost, erect the works on the city's leased ground at Atlantic Avenue, within half a mile of the City Hall; should operate it for ten years, the city having an option for the purchase of the works at the end of five years; that the annual payment to the company should be $5,500—and it should have the sole control and possession of all the marketable portions saved from the refuse. All the collections were to be made by the city; and it was provided that the refuse should be delivered in a dry state, without previous picking over or any interference by street scavengers. The works were completed and went into operation in January, 1899.

The plant comprises a brick building 162 feet long, 80 feet wide, the roof supported by steel columns. About one-half of the floor space is excavated to form a sub-cellar in which are placed the baling presses and the destructor, with boiler, engines and machinery, divided from the main room by a cross-wall of brick.

Through the center of the main room runs an endless belt or steel apron 4 feet wide and 150 feet long between centers, carried on rollers supported on a steel framework.

The first section of this belt for twenty-five feet is at the ground level, the next section of ninety feet is two and a half feet above the picking floor, and the last thirty-five feet rises on an incline, discharging into a bin placed outside the rear end of the building.

On each side of the tract of 90 feet are placed hoppers or picking bins, which receive the various classes of papers, rags, cardboard and other articles. These hoppers discharge into the baling presses in the basement below.

Behind the cross-wall, which divides the picking room from the fire room, is placed the destructor, which is 50 feet long, 13 feet high and 10 feet wide, with a steel self-supporting chimney 140 feet high. On top of the furnace are two feed-holes into which the refuse is discharged by means of a chute or pipe placed under the end of the endless belt or apron.

A steam boiler, 60 horse power, is placed on the end of the furnace next the stack, and connected with two engines, one of which drives

the conveyor or endless belt and a fan or blower for separating the sand, dirt and heavy miscellaneous substances from the lighter refuse; the other an electric dynamo for lighting the building.

The city carts enter from the street, passing over scales where the loads are weighed, and discharge their contents upon the conveyor. The mixed mass passes between lines of men stationed alongside the conveyor, who pick out the several kinds of paper, rags, etc., allotted to each, placing these in the hoppers through which they pass to the presses below. The parts of the refuse rejected by the pickers are carried by the conveyor up to the receiving bin, where the fan or blower separates the light combustible portions from the dirt, sand, broken crockery and material which will not burn. The receiving bin has a capacity of 200 cubic yards, but by means of the chute the refuse may, at will, be conducted in a continuous stream into either feeding hole of the destructor, this work then being automatic.

The destructor is in many respects different from any furnace heretofore established in this country. The peculiar kind of material to be destroyed, the need for rapid combustion of large amounts, the necessity for maintaining continuously a given pressure of steam, and the fact that the work must be done without unsanitary consequences, called for the design and construction of a furnace and accompanying machinery that present many novel features.

The operation of this plant demonstrates that the every condition of the specifications made by the engineers have been fulfilled. The refuse is received, conveyed, sorted and baled; the worthless parts are burned with no loss of time and with the minimum of labor; the works are operated, lighted, heated and ventilated, and the steam power obtained is far more than is required for the engines.

The continuous operation for nearly a year, and the fact that a similar works are to be erected in another part of the city not covered by this one, is sufficient evidence of the value and efficiency of this method.

Through the courtesy of Mr. O'Shea, Superintendent of the Sanitary Division of Boston, I am able to give some exact details of collection service that will be useful for comparison.

The refuse is collected from an area included in a circle of two miles from the City Hall, containing all the business district and a proportion of the resident section, the population of which is 140,000—and covering ninety-five miles of streets. The collection is made daily by twenty-four special carts holding four cubic yards; drawn by one horse attended by one man. The daily number of loads varies with the season, the largest day—in October—being 140 loads—540 cubic

yards; the smallest in January—12 loads—50 cubic yards. The total number of loads from March 1st to September 1st, 1899, was 7,888.

The average for the summer months may be taken at 52 loads—217 cubic yards—weighing 807 pounds, net, per load; or about 22 tons daily.

For the same territory and the same period—142 working days—there was collected 68,118 loads of ashes, weighing 1,943 pounds per load, and 14,363 loads of household offal (separated garbage) weighing 2,300 pounds per load.

Assuming the component parts of this refuse to be the same as in New York, then:

35% would be marketable,
60% is combustible for fuel,
5% is worthless, and must be hauled away with the ashes from the Destructor—which is about 17% in weight of the original bulk of material collected and brought to the works.

The utilization of the surplus heat from the cremation of refuse is a factor which must henceforward be taken into account in all aspects of this question. With the single exception of the two waste disposal stations in New York and Boston, there are no cremating furnaces in this country that utilize the heat from the refuse; and in these only a fraction of the power is employed.

Without a lengthy test of this value of waste as a fuel, we cannot accurately estimate the amount of power obtainable from a given amount, but enough is known to indicate that a great saving can be made by the adoption of measures that are proven to be successful.

Taking as the average 200 cubic yards daily collection from 200,000 people, and selecting out 35 per cent. of this as marketable, there remains in bulk 120 cubic yards to be burned. In weight this will exceed the average of 207 pounds per cubic yard, since it includes matters and articles of no value for sorting, but burnable for fuel. Barrels, boxes, bits of wood and coal, sawdust, berry crates, broken furniture, oil-cloth matting, old carpeting, mattresses, excelsior, paper of all kinds and quality in small pieces—but large in the aggregate amount—comprise the discarded refuse.

This material fed continuously into a destructor will produce a heat at the highest temperature of over 2,000°. Glass, iron, sand, dirt, stone and bits of coal, if allowed to enter the furnace, will fuse into a semi-liquid mass that must be broken up and removed in clinker. A boiler of 60 horse power is maintained at maximum pressure, and the dampers must be kept open for escape of surplus heat.

There can be no doubt but that 100 horse power can be developed and maintained for ten hours with this amount of fuel. In New York

the conditions are much the same, though only the lightest part of the refuse is burned. Probably not more than 60 cubic yards in 10 hours are destroyed, and 75 horse power is obtained—of which less than 10 is employed.

The English engineers have for years past experimented on the fuel value of various wastes, and their reports have a peculiar interest for us, since they represent accurate tests by experienced men of high professional standing, and are officially reported for the information of the municipalities ordering the trials.

The tabulated reports of disposal of seven different places will give a clear idea of the quantities of refuse, the water evaporated, the cost of operating, and the uses of the power developed. (See next page.)

An examination of these and other reports show that every variety and class of municipal waste is destroyed without nuisance at small cost, and that the heat produced is turned into power. It appears that about 10 pounds of unsorted town refuse and 20 pounds of mixed sewage sludge and unsorted refuse are each equivalent in fuel value to one pound of coal.

There is about 33 per cent. of a residuum in weight, and 25 per cent. in bulk, left of the original amount, and this has some value for commercial purposes or municipal uses. The heat units in one pound of waste will evaporate one pound of water, though this of course varies with the presence of moisture, of fine dust in the waste and other conditions.

The disposal work at Hamburg and Berlin, as reported in the valuable information collected by Mr. Rudolph Hering, presents some interesting features, and may be briefly noted.

The Hamburg works is the largest single plant yet erected, providing for the disposal of the miscellaneous waste of 300,000 people. Following the English construction, the installation comprises 36 separate cells, each of which destroys from 8 to 12 tons daily, operating boilers of 250 horse power, which drive two dynamos for lighting the works, and provide energy for two cranes used in hoisting, two fans or blowers, and also furnish steam for heating public baths and for the work of the City Disinfecting Station adjoining, besides 100 horse power not yet utilized.

The refuse is unsorted, poor in quality, and leaves a residuum of 55 per cent. in weight and 40 per cent. in bulk. The clinker is passed through sieves, and when separated into several sizes, finds ready sale. The cost of working is 20 cents per ton, not including the fixed charges for interest, etc.

The Berlin plant is smaller and not so effective, comprising eight cells without boilers. It was at first impracticable to burn the refuse

COMPARATIVE REPORTS FROM SEVEN ENGLISH CITIES.

CITY	Destructor	Character of Refuse Destroyed	Nominal boiler capacity in horse-power.	Horse-power developed	Refuse Burned —lbs.	Water Evaporated —lbs.	Pounds of water per pound of refuse	Tons per cell per day.	Cost per ton for labor (cts.)	Use of Power
Warrington . . .	Beaman & Deas	Unsorted town refuse	200	200	18508	27800	1.5	16	19	For operating 17 engines for making manure, lighting works, for city workshops, making mortar, etc
"	"	Unsorted refuse from Collin Green Colliery	200	200	13272	28000	2.11	18	17	NOTE — Town refuse brought to Warrington Destructor for special test.
"	"	Town refuse from Leeds	200	127	53536	61344	1.14	23.5	18	do. do.
Leyton	"	Sewage sludge unsorted	100	133	25116	31920	.50	16	32	For lighting works, making mortar, and city workshops.
		Town refuse	.....	.....	49840					
Oldham.....	Horsfall.....	Town refuse	120	120	106980	78600	.88	6.25	20	Auxiliary power supplied to city electric light station, etc.
Loughborough.	City Furnace ..	Town refuse	90	90	35000	70000	2.	12	27	Employed in pumping sewage. Annual saving in coal, $2,000.
Rochdale.....	Meldrum	Town resuse	180	120	26240	31552	1.64	10	20	Operating engines for lighting works, making manure and mortar, etc.

without adding coal, but this difficulty is now overcome by screening, though it is still impossible to produce heat enough for steam purposes, which is supplied by a separately fired boiler. The refuse contains but 1.26 per cent. of burnable coal and clinkers as against 28 per cent. in English refuse—the difference being attributable to the fact that in Berlin a poor quality of bituminous coal is used, the residuums from hard coal being more combustible than those from bituminous, the latter when not screened being found to retard rather than to aid the combustion of the refuse.

When this refuse was sifted, and a blast of air was used instead of steam jet, the efficiency of the furnace was greatly increased. There was no sale for the clinker except for filling ground. Street-sweepings could not be made to burn without the addition of fuel.

The cost of several items of municipal service may be quoted for comparison with the expense in American cities.

COST PER CAPITA PER ANNUM.

Present collection of refuse and disposal outside the city	$ .35
Cremation of unsifted house refuse	.22
Cremation of sifted house refuse	.15
Street cleaning	.25
Sewerage	1.24
Water supply including filtration	1.10
Public lighting	.70

SUMMARY OF DISPOSAL WORK IN ENGLISH CITIES.

At the beginning of this year there were eighty-one cities and towns in Great Britain employing cremation as their chief means for waste disposal. There were in use 867 cells or separate small furnaces; and reckoning each of these to destroy 6 to 8 tons daily, then something like two and one-fourth millions of tons of unsorted house refuse and sewage sludge are annually burned.

Of these eighty-one places, seventy-six utilize the heat developed by cremation for one or another useful purpose. Fourteen cities use the power for electric lights in the works, and eleven employ it as auxiliary to the electric-power plant of the place. At fifty-two places there are mills that grind the ashes and clinker for mortar, or crush it to suitable size for making roads or foot-ways. As a basis for concrete work and as a substitute for sand, blocks made with destructor dust stood a strain of 40 per cent. greater than when made with sand and pebbles.

There are six cities and towns employing the steam from disposal works in the City Disinfecting Station—a practical and economical purpose of the highest utility and benefit. Seven places utilize this force for manufacturing manure, and eight for running the city work-

shops and forges. In the larger cities, to save expense in hauling, the disposal stations are multiplied, being placed in different locations—sometimes in the center of a thickly populated district. London has five disposal stations, Liverpool three, Glasgow five, Bradford four, Birmingham three, Leeds four, Manchester four, etc.

At nineteen places the sewerage works are operated wholly or in part by the power from the destructor plants. At one city there are thirteen cells operating at a cost of 12 cents per ton of refuse destroyed, developing 250 horse power, daily generating steam for pumping three million gallons of sewage through a 20-foot lift, operating air-compressors for lifting sewage from precipitating tank, driving mortar wells, producing electric lights for the works, and supplying power for the shops and forges of the city service. The steam power obtained from the burning refuse is sufficient for the purpose of pumping and chemically treating the sewage without the aid of other boilers fired by coal.

A few instances may be quoted where the use of power is specially noticeable:

BATH. Population, 50,000; produces 40 tons of waste daily, collected at a cost of 81 cents per ton; cost of disposal, 22 cents per ton. The clinker—about 33 per cent. of the bulk dealt with—is used for mortar and paving slabs, and finds ready sale.

DEWSBURY. Population, 30,000. A two-cell destructor consumes 30 tons per day at a cost of 26 cents per ton, developing 80 horse power used in wheelwright and blacksmiths' shops, and for crushing clinker into dust for mortar, which sells for $1.75 per ton.

LLANDUDNO. Population in summer, 30,000. A four-cell destructor consumes 30 tons refuse daily. The works are built in conjunction with city plant for electric lighting, and the power from the destructor supplies 50 arc lights of 1,000 candle power, and 4,000 incandescent lamps—about 80 per cent. of the whole street lighting for the town.

ST. HELENS. Population, 85,000. Destructor of four cells just installed; power developed, 200 horse power, will be exclusively employed for operating dynamos for electric railroad seven miles in length, and for lighting the works and shops.

CANTERBURY. Population, 23,000. Combined destructor and municipal electric works now being erected, comprising one pair of Beaman and Deas Destructor cells, each required to cremate 15 tons of refuse in 12 hours, developing one pound of steam from one pound of refuse during ten hours, with accumulators for storing the current generated in daytime for night use.

SHOREDITCH. The largest installation of refuse destructors and electric light works is at Shoreditch, a district of the City of London,

containing 124,000 population. The location is in the center of the district and has also in connection, public library, public baths and wash houses supplied with heat from the destructor station. There are 12 cells of a capacity of 8 to 12 tons per day, working continuously, evaporating one pound of water with each pound of refuse consumed, operating six water-tube boilers, 1,000 horse power, working at a pressure of 200 pounds. The electric light being required on a large scale only four to six hours, it is obvious that an immense amount of heat would be wasted unless some means of storage is devised. This is provided by a Thermal Storage Cylinder 30 feet long, 8 feet in diameter, into which all the steam gathered in the day time is passed, where it is mixed with a small quantity of cold water, the proportions being such that when evening approaches the cylinder is full of water at the temperature and pressure required by the engines. The cold water feed is then shut off, and the feed water supply of the boilers connected, supplying these at such a temperature that the fuel that is then being burnt has merely to furnish heat sufficient to overcome the latent heat evaporation at the required pressure. By this method about one-third more steam is obtained, and the water is purified for boiler uses.

The latest unofficial reports state that the works now operating for nearly two years, are successful in every respect. The street refuse has been disposed of with a saving of two shillings per ton over methods previously in use, and electric light has been supplied at a reduced rate. Negotiations are now going on for the purchase of land and the construction of a similar plant in two other city districts; one of these will cost more than one million of dollars to complete.

The example offered by this most successful experiment is being rapidly followed by other communities, no fewer than thirteen distinct municipalities in Great Britain being pledged for the construction of joint works, utilizing the destruction of town refuse for power for electrical purposes.

The cost of construction of power-producing plants comes naturally at this point, and this is a question that is difficult to answer.

The initial expense, exclusive of ground, depends upon the preparation of the foundation, the character of the enclosing buildings, the material and height of the chimney, the length of the roadways and approaches, and the local prices for material and labor. Since the conditions and circumstances of no two cases are precisely alike, it is impossible to give exact figures; but it may be stated in a general way, that a disposal plant which is to utilize the power, will cost from one-third to one-half more for initial expense than one which does not employ the heat developed.

This extra item is for the boilers and machinery, and for the more massive and endurable construction of the furnaces, chimneys and buildings. A destructor of the improved type, not utilizing the power, will cost but little if any more than a crematory furnace of the usual kind having the same relative capacity, and can be depended upon for greater efficiency, with better sanitary protection from nuisance.

In American towns the practical use of power from burning refuse may not at present be convenient. Probably it will be difficult to make a radical change in the present methods, owing to the fact that most city departments where power could be employed, are carried on by contract with powerful companies for a long term of years, and these are naturally opposed to the adoption of any measures that may interfere with their business. But there is one instance where the use of this force is peculiarly applicable, which may be briefly noted. It almost always happens that power in some form is needed in connection with sewerage systems—usually when the sewage is to be raised to a higher level for filtration or outfall. If this point is within reasonable distance from the town, there can be saved the expense of one steam equipment by adding a destructor for consuming the town waste and sewage sludge, and transforming what is now worthless and useless into a beneficial force. This is well within the reach of even the smallest places that are compelled to adopt the sewerage system, and has been pointed out and recommended by a prominent engineer in the case of a small inland city about to put in a filtration plant; and this example, if only fairly successful, will be followed by many others.

COMPARISON OF AMERICAN AND FOREIGN METHODS.

Considerable space has been given to the description of foreign work for the reason that it seems to give economical and efficient returns that are far in advance of our own practice.

It now remains to be seen if the conditions and circumstances that obtain in American cities are the same in those abroad; or if there can be devised in this work of disposal, a similar use of means and measures that will give equally good results.

In considering this point we are hampered by the fact that not a single American city has thought it worth while to make any official test of furnaces or apparatus for reduction, or to collect and publish accurate information as to the relative proportions or weights of the component parts of municipal waste.

The only exception is New York City, where the system of reports instituted by the late Colonel George E. Waring, and the method begun by him for collection and treatment of a part of the combustible refuse, has been continued by his successor. This information is a

most valuable contribution to our knowledge on this question, and is included in the paper by Mr. Macdonough Craven, read at this meeting.

Through his courtesy I am able to quote some facts applicable to our inquiry:

For 1898, the total amounts of waste collected in Manhattan and Bronx Boroughs of New York City was:

Ashes, excluding street sweepings	1,121,000
Garbage	170,000
Refuse	102,000
Total tons of 2,000 lbs	1,393,000

Taking the population of the Boroughs as reported by the State Board of Health, 2,048,830 would give 680 tons per 1,000 people; or 1,300 lbs. per capita per annum.

The estimates by the best authorities for the city of London, give 250 long tons per 1,000 persons, or 560 pounds per capita per annum; and in Berlin the figures are 315 lbs. and in Hamburg 345 lbs. per capita per annum.

These figures show an enormous percentage of waste produced in New York over foreign cities, due largely to the facts that it has a large transient population; that this is a great receiving and distributing point for the whole country; that the city is more compactly built—the ground completely occupied, allowing no storage room or any means of disposal in the house; therefore, everything must be sent away.

But the wastefulness and extravagance of the American people in the direction of household products has long been noticed and commented upon by foreign observers; and it has been stated as fact that, in the matter of food alone, enough is thrown away daily, if it were properly cared for, to sustain nearly one-fourth of the whole population. This wastefulness is characteristic of all American cities, but not in so large a degree as in New York, owing to conditions that do not obtain elsewhere.

The component parts of municipal waste must be known before one can obtain an idea of their value for any useful purpose. The following table, compiled from the best foreign authorities, and including what is accessible here, will give some details not previously published. (See table, next page.)

In examining this table there appears to be no radical difference in the general character of municipal wastes here and abroad. There is here a greater amount of garbage containing more water in suspension, a larger proportion of coal, and far more combustible refuse comprising articles and items that are not discarded from foreign homes—a striking instance of American abundance in all relations of home life.

		BOSTON	NEW YORK			LONDON				BERLIN	
		O'Shea		Craven		Maxwell		Codrington		Hering	
	Component Parts	Per cent of collection from 140,000 persons.	Per cent of 100 Component Parts of each Division.	Per cent of whole collection by weight.	Totals per cent by weight.	Per cent by weight.	Totals	Per cent of Whole Collection	Totals	Per cent of Total City Collection.	Totals
ASHES	Coal	.....	20.	16.10	.....	.84	.....	.15	.....	.17	.....
	Breeze-Cinder	75.58	15.	12.07	.....	63.69	.....	28.80	.....	2.64	.....
	Fine Ashes	.....	50.	52.30	80.47	19.51	84.04	52.60	81.55	50.16	52.97
GARBAGE	Vegetable and Animal Matter	20.49	12.20	12.20	12.20	4.61	4.61	14.20	14.20	32.54	32.54
REFUSE	Paper	3.93	74.5	5.46	.....	4.28	.....	.....	.....	4.26	.....
	Rags, Clothing, etc		12.2	.89	.....	.39	.....	.43	.....	1.15	.....
	Carpets		3.3	.24	.....	.....	.....	.....	.....	.....	.....
	Bottles		2.5	.18	.....	.96	.....	.30	.....	.....	.....
	Metals		2.1	.15	.....	.21	.....	.37	.....	.20	.....
	Tins		1.4	.10	.....	.79	.....	.....	.....	.58	.....
	Leather		1.9	.13	.....	.....	.....	.....	.....	.....	.....
	Rubber		5.2	.01	.....	.....	.....	.....	.....	.....	.....
	Barrels (whole)		1.4	.10	.....	.....	.....	.....	.....	.....	.....
	Bones		.....	.....	.....	.48	.....	.25	.....	.53	.....
	Wood		.....	.....	.....	.....	.....	.....	.....	.40	.....
	Glass		.....	.03	.....	.47	.....	.....	.....	1.27	.....
	Crockery		.....	.....	.....	.55	.....	2.90	.....	6.10	.....
	Straw Fibre, etc		.....	.....	.....	3.22	.....	.....	.....	.....	.....
	Other Salable Matters	.....	.5	.04	7.33	.....	11.35	.....	4.25	.....	14.49
NEW YORK CITY	Total per cent	100.	.....	.....	1.00	.....	100.	.....	100.	.....	100.
	Combustible refuse for fuel		60.	.....		.....	.....	.....	.....	.....	.....
	Incombustible refuse	.....	5.	.....		.....	.....	.....	.....	.....	.....
	Marketable refuse	.....	35.	.....		.....	.....	.....	.....	.....	.....

The value to be obtained from the dry refuse of municipal waste in market products, depends something upon the nearness to factories where these articles are worked up and transformed into new material; also upon the demand and supply for certain items, like paper, cardboard, etc., which are the largest in quantity. Broadly speaking, everything has a value and can be sold at some price; and when taken together, will return a revenue equal at least to the cost incurred for the expense of separating and sorting.

When the whole of the combustible portion of city waste is converted into power, then the figures rise at once to greater magnitude. For the purpose of illustration, suppose we consider the theoretical value of the New York waste. Assuming the amounts to be those already stated, and the value in steam power as indicated by the reports quoted, we should have something like the following:

35% of ashes=1,121,000 tons.....392,350
60% of refuse= 102,000 " 61,200
10% of garbage=17,000 " 17.000

470,550 tons of fuel

equivalent to 47,000 tons of coal, taking ten pounds of miscellaneous waste as equivalent to one pound of coal.

Taking the average of power developed under usual conditions at a conservative estimate per horse power per annum in New York City, and adding to this the value of the sorted refuse at the present market price, and we shall have, approximately, $500,000, as representing the fuel and the marketable value of the present yearly collection of New York garbage, ashes and refuse. From this must be deducted the cost of transporting to place of final disposal the 10 per cent. of residuum left after destruction by fire—the cost of which is more than defrayed by the value of the land created by these ashes.

The statement made some years ago by the late Colonel Waring, to the effect that the waste of New York was worth some millions of dollars per annum, was probably based on some such estimate as this; adding also the utilization of the steam power for electric lighting or manufactures.

Colonel Waring's last pubilshed predictions of a recovery from the sale of refuse material of one-half the whole cost of the street cleaning and disposal work, seems now likely to be in a fair way to be put to the test by the action of the present Street Commissioner, who will presently begin the erection of the first refuse disposal plant of large capacity at one of the city wharves.

Judging from the reports quoted from, it is evident that there is a very considerable value in municipal waste, when properly treated, which is derived from the saving of marketable articles, the employ-

ment of the enormous force acquired from the cremation of worthless matters.

The means for both these methods are now available. The utilization of power is a question of the near future, and it is only reasonable to say that when once it is determined how much, how often, and at what price this power is to be had, there will be open a way for its use.

Meantime, the additional expense for producing the power is not a large factor in the question, inasmuch as it secures absolute immunity from the nuisances of dumps, destroys the waste without insanitary consequences, saves a considerable sum in transportation and provides in the residuum a material for various useful purposes. Under most conditions it certainly is desirable to accept the offer of private companies that are in a position to undertake this work; but if this is done there must be granted a term of years for the contract, to give a sufficient margin of time in which to repay the fixed charges of construction and operation of the plant, and to realize a profit.

But a change must be made in our present manner of determining what is needed, and deciding upon its efficiency. This subject of waste disposal is at a stage wher it must be considered as much a part of the municipal service as sewers, or gas, or water supply, and treated with the consideration the subject demands.

We are only too familiar with the way this question is now often handled. After the initial remonstrance and petition for a new order of things—which springs from the health authorities, who first recognized its importance—comes the somewhat tardy action of the Mayor calling attention to the subject; the tour of inspection by the council committee; a deluge of pamphlets, circulars and letters; the keen hunt of furnace builders and ambitious companies anxious to save the city all worry and trouble—for a consideration; the contradictory bids, tenders and offers that no man can reconcile; then the rejection of everything—and the repetition of these proceedings until everybody is sick and tired of the whole business, the prize at the last falling to him who is the longest winded, and the city gets a bad bargain that makes endless trouble in the future.

But there must be a better way. Suppose it is determined that some one of the modern methods of waste-disposal is needed; the city engineer would be instructed to procure the latest reliable information of methods and apparatus. If necessary, he would be authorized to call in an expert on the subject for assistance; he would carefully compile this information, and with it the accurate account of amount and character of city waste, and add the suggestion of what may or may not be done in the utilization of refuse, and of power from destructors. With this report in hand, the authorities would be in a position to de-

termine what are the apparatus and methods available; and a careful inspection—and, if possible, a trial—of the best be made by competent men. Then bids are asked for under such definite conditions as are equitable and fair—not expecting the impossible to be accomplished offhand, but giving some freedom and latitude within well-defined bounds, and then holding to strict fulfillment of the contract on both sides.

Ten years of garbage-disposal work in American cities has seen the establishment of sixty-five furnaces in fifty-four cities and towns, besides the trial and failure of about ten experiments of one kind or another in crematory furnaces. The same period has witnessed the construction of twenty large and expensive plants for the reduction of garbage by mechanical and chemical method. Of these, eight now survive, and of these only three or four are reported to be satisfactory and economical, among the latter being those of New York, Philadelphia and Boston.

The expense of construction in these furnaces has not been large, nor the cost of maintenance excessive when compared with the results accomplished. From the beginning the tendency has been to overrate the capacity and efficiency of the furnace, and underestimate the quantity of waste produced; for it always happens that when a way is provided for disposal of worthless matters the quantities invariably increase. When compared with what is yet to be done, what has actually been accomplished is of small magnitude. Because of the limitations of the furnace capacity in consequence of its principles of construction, there is no example on a large scale of the disposal of all classes of waste by cremation. The smaller cities and towns have found cremators useful and efficient, but limited strictly in capacity and performance. The large cities, with one exception, have not ventured upon their adoption, though there has been shown a willingness to put them to trial under conditions that could hardly be met—the destruction of all kinds and quantities of miscellaneous matters at small cost.

Finally. We have reached a turning point where some larger and more efficient means must be brought forward if the best methods are to be adopted. Clearly, the great interest shown in the subject, and the growth of public sentiment in favor of the sanitary treatment of waste, has created a demand that must be met.

The example of two cities in turning to account such part of refuse as can be easily selected from the general mass, indicates what may be done in this direction. When once separation is determined upon, and the householder fully acquainted with the necessity and expediency

of this measure, he readily falls into line, and cheerfully contributes his personal quota to the general reform.

We can depend confidently upon a sure revenue from what has previously been thrown out as worthless—if not in articles and substances saved and sold, then in fuel value for other uses.

While American cities have been slowly working out the problem of waste treatment, other countries, proceeding on parallel lines, with a wider experience born of a stern necessity for the sanitary disposal of the wastes of a crowded population, and with far more liberal expenditure of funds for this department of municipal work, have gone more directly to the end, and reached conclusions that apply equally well in both countries. Why may we not profit by the example set us, and turn into power the useless matters we are burdened with?

There is no good reason to be urged against this. The inventive genius of the American engineer will speedily find means to adapt methods and measures that are labor and money saving, and find uses for power that, so to speak, is created out of nothing. Give him a chance to do this, and the cities of America can realize the predictions of scientists who, three years ago, said that each community may be served with electric light created from the natural waste and outcast substances that we now pay huge sums to get rid of.

From a consideration of the relative methods of disposal in use in this country, and comparison with those which are found in favor abroad, we may fairly draw the following conclusions:

First. But two ways or means for dealing with this question are available, and the relative advantages and special adaptations to the local conditions can only be determined by scientific and expert investigations and comparison. The subject has gone beyond the speculative and experimental stage, and reached the point where more definite and exact knowledge is needed. This can best be had by calling in the assistance of experts who will make full examinations and submit reports covering the whole ground.

Second. The indications are that a combination of the two systems of reduction and cremation at points where the two can be advantageously combined because of the presence of sufficient quantities of municipal waste, is the ideal way in which to treat city waste. Each of these methods developing along parallel lines have come to a place where they begin to converge to a common point. Reduction has demonstrated its ability to secure a percentage of value at a greater or less cost, according to the amount of garbage treated, but it does not provide for the still greater proportion of city waste left untouched. Cremation destroys the combustible and a proportion of the putrescible, and recovers little or nothing of value in the process; but the em-

ployment of the heat derived from cremation furnishes an additional source of revenue that should now be utilized.

THIRD. A city which has or will put into force a system of separation and collection of garbage, ashes and refuse, and will erect a disposal plant which shall proceed by treating the garbage, when in sufficient quantities, by the modern improved process of extracting the valuable commercial products, and shall operate its plant by the steam power which is obtained by the combustion of such worthless parts of the dry refuse as may be left after sorting out the salable portions, and that will, in addition, bring to this point such proportions of ashes from houses as can be utilized for fuel for the destructor, will then have all its waste disposed of in a way entirely sanitary, and will realize a profit in the operation which, in a comparatively short time, will repay not only the cost of the works and their operation, but will return in steam power, when utilized for mechanical purposes, a very considerable amount of profit.

FOURTH. When the quantity of garbage produced is insufficient in amount or impracticable for treatment by reduction methods, there can be erected a General Waste Disposal Station which will receive every class of waste in a mixed condition, and by employing the best available destructive agencies can transform this worthless matter into electrical energy as principal or auxiliary power for street lighting or other useful municipal purposes.

FIFTH. Any smaller city or town can employ destructive methods for its waste disposal, with guaranteed immunity from nuisance, at a smaller relative cost for operating the work than has been known since the beginning of this movement twelve years ago.

A REPORT OF WORK WITH ANTITOXINE AND FORMALDEHYDE AGAINST DIPHTHERIA.

By Dr. C. HAMPSON JONES,

Commissioner of Health, Baltimore, Md.

On March 14th, 1898, I took charge of the Baltimore City Health Department. Four months later there was put into effect the following regulations: According to Sect. 175, of our Health Ordinance, the health commissioner was required to notify the public, by displaying a flag or other device, that infectious disease was within the house. A card is now displayed for diphtheria and scarlet fever in addition to smallpox and yellow fever. The order was issued that the card should not be removed until after the room had been fumigated with formaldehyde. The order to fumigate was to be given after the throats of every one in the infected house had been shown to be free from germs as far as one culture could show, but if anyone showed the presence of germs, the card remained displayed.

In September the order was issued that every public school (and others if they desired) should be officially notified semi-weekly that diphtheria or scarlet fever existed in certain families living on ——— street at ——— number, and the principal of that school was not to allow anyone from that house to attend school until permitted by the Health Department.

These precautions (extraordinary for Baltimore) were deemed necessary for the following reason: If you will carefully note this table you will observe that from 1894 to October, 1897, the City of Baltimore had about the usual number of cases that exist in large cities (although I contend that by persistent work diphtheria can be made as rare as smallpox.) In that month there were 247 cases of diphtheria—November, 330—December, 384—and January, 231 cases. Indeed, we have a warning as far back as December, 1896, with 139 cases, and the following January, '97, 119 cases.

During all this time nothing of a systematic character was done to antagonize the progress of the disease, which was due to the want of funds. It apparently lessened naturally; there was no attempt made to use antitoxine nor was any regulation made to systematically fumigate every house infected. Fortunately I was an inspector at this time, and knew the conditions. Without a hospital and without a steam disinfecting plant, we had to face a probable epidemic in the fall of 1898.

You will notice by observing the table that the drop in the curve took place in December of 1898, instead of January or February of the following year, as is usually the case.

If you compare the months in 1899 with those of 1898, you will find that there is something in favor of every month of 1899 except March, where there is a difference of three cases against 1899.

Unfortunately for Baltimore, the free gift of antitoxine to all applicants had to be considerably curtailed in June, 1899. And it was only when an outbreak occurred in the "duck mill" district that more money was given the department for the work.

This outbreak is of interest to us inasmuch as it affords a better opportunity than usual for the observation as to the value of antitoxine as a preventative. Baltimore produces a very large quantity of cotton duck, and the mills of the companies are located close together at Hampden and Woodbury, and they have a large colony of families.

In August last I noticed that my map was showing a concentration of cases in Hampden and evidently trouble of considerable proportion was developing. The people are poor and blessed, or otherwise, by a large number of children. The houses are small and consequently the children mingle together a great deal on the vacant lots. After presenting the facts to the city authorities money was given us for the work. A squad of officers to make cultures of the children's throats was at once sent and we found 17 pure cultures. We asked the privilege of injecting with 1,000 units of antitoxine, not only into those whose throats were infected, but also other children not infected in the same house. This privilege was granted in all cases except one (and this one had a pure culture.) Not one of the 152 children immunized developed clinical diphtheria, but the one not immunized did develop a bad case of diphtheria.

This year we are still quite considerably behind last year's records (about 60 houses for October), but by no means are we anywhere near safety. We are enabled to keep the disease within bounds by the cooperation of the school board, who have seconded our efforts willingly and energetically. My map occasionally shows that the neighborhood of a certain school shows too many cases of diphtheria. We immediately order a squad of officers to make cultures of the entire school, including the teachers, and we have invariably found a number of throats infected and not unfrequently a teacher's throat also. These are ordered home and in spite of all protests on the part of parents armed

sometimes with certificates from their family physicians stating that nothing was wrong with their children's throats, they were kept home until our officers declared them safe.

I am glad to say that in many instances the value of sending children home has been demonstrated by the subsequent development in the majority of them of clinical diphtheria.

We have found that these visits to schools have resulted in every case in a subsidence of the disease in that neighborhood at least for a time.

In addition, I might state that we have found it necessary to abandon the use of pastilles entirely and use formalin because of the expense, the necessity of using many lamps and the danger from fire.

We use control cultures in nearly every room to be disinfected, and we find that the generators now in use when heated for 20 to 30 minutes will destroy the control cultures. At this time I cannot say whether the method of disinfection really prevents further development of the disease within the same house, but I do know that the children immunized do not develop the disease.

I desire to call attention to the change in the percentage of deaths in the later years, which has been due to the use of antitoxine:

Year	Cases	Deaths
1894	409	231
1895	629	310
1896	653	281
1897	1620	358
1898	2077	412

In 1896 the physicians began to use antitoxine—today we have a few who do not believe in its value or else employ it after all things else have failed. We believe that the still unnecessarily high death-rate is due to the negligence of parents in not calling attention to the condition of their children's throats.

The department has not lost a case that was seen by us within the first two days of the disease and lost but few when seen later than this, as is shown in the last outbreak in Hampden. In 143 cases there were ten deaths, two of these no antitoxine had been given; two children received only 1,000 units after three days had passed; the final six cases were from six to eight days with the disease before receiving antitoxine:

	1894		1895		1896		1897		1898		1899	
	Cases	D'ths	Cases	D'ths	Cases	D'ths	Cases	D'ths	Cases	D'ths	Cases	D'ths
January.....		20	85	26	54	25	119	46	231	32	137	27
February.....		17	46	22	61	27	88	17	159	31	121	34
March		15	37	17	45	20	88	23	102	28	105	25
April.....		15	46	18	38	20	71	23	86	21	79	9
May		7	30	12	31	16	66	17	71	14	63	9
June.....		5	21	17	43	19	55	17	99	27	68	17
July.....		7	25	14	15	10	37	8	106	40	49	17
August.....		21	39	24	25	11	46	23	153	22	128	19
September ...		11	38	28	41	21	89	25	262	46		
October		24	62	30	66	28	247	60	284	54		
November....		43	101	47	05	35	330	55	322	60		
December.....		46	99	55	139	49	384	44	202	37		
Total.....	409	231	629	310	653	281	1620	358	2077	412		

REPORT OF THE COMMITTEE ON DEMOGRAPHY AND STATISTICS IN THEIR SANITARY RELATIONS.

To the President and Members of the Association—The work of the committee throughout the past year has been confined to carrying out, as far as possible, the spirit of the resolutions adopted by the Association at the last meeting relative to vital statistics. It is gratifying to be able to state that on the whole much progress has been made. These resolutions relate (1) to the securing of more satisfactory mortality statistics, especially for non-registration States, under the U. S. Census; (2) to the adoption of a uniform classification of causes of death, with provisions for its regular revision from time to time in order to keep pace with the demands of science; and (3) to the adoption of the accepted classification (the Bertillon system) by the governments of the three countries embraced in the Association for the censuses of 1900 and 1901. The report will take up these subjects in order and will conclude with some general recommendations for the ensuing year.

RELIABLE REPRESENTATIVE STATISTICS FOR NON-REGISTRATION STATES.

Resolved, That the American Public Health Association earnestly recommends that a plan be incorporated in the act to provide for the taking of the next United States Census whereby reliable representative vital statistics may be secured for the non-registration States.

It will probably not be necessary to assure the members of the Association who have watched the course of the attempted influence of governmental action by the sanitarians here represented in other matters, such, for example, as the establishment of a Department of Health at Washington, that the fact that the urgent recommendations of this Association for improved methods in the collection of mortality statistics by the approaching Federal Census were given no consideration by the powers that shaped the census legislation does not militate in any way against the necessity and practicability of such modifications in the law, nor argue any neglect on the part of the committee in urging the wishes of the Association. The members of the committee were not authorized to proceed to Washington in the interests of this legislation, and without such personal attendance, it is quite impossible to estimate the "influences" that prevailed against the measures proposed.

The modifications that were asked for were very few, and depended solely upon the approval of the Director of the Census, in his reasonable discretion, for their practical application. It was only proposed to

add to the bill which finally became a law that the Director of the Census "Shall have authority, in his discretion, to collect vital statistics from representative areas of non-registration States, in order to test the results of the Census enumeration of deaths, and determine the percentage of omissions," without which knowledge, as we all understand, the published results of the Census statistics of mortality are not only unreliable and worthless for many purposes, but are even positively misleading. The pernicious limitation, which now appears in the law, confining the special investigations of mortality statistics to registration areas should also be stricken out, so that data might be obtained from non-registration States if it should prove feasible to do so. These changes were presented to the Senate Committee in charge of the original bill, and were also called to the attention of the Chairman of the House Committee, which presented the substitute bill which became a law. The Chairman of the House Committee which had this matter in charge refused to consider this arrangement, and this refusal operated to exclude the matter from the conference of the committees of the two houses, and hence from the law as passed.

At the last moment of the session, and after it had appeared to be impossible to secure a proper hearing on this subject, which had already been predetermined on the lines of the blundering inefficiency of former censuses, the Chairman of this Committee found it necessary to proceed to Washington on business connected with the Michigan Department of State, and with the most cordial co-operation of the other members of this Committee and many State and municipal registrars, members of this Association and practically conversant with the necessities of the case, prepared and presented to Congress, through the kind offices of Senator McEnery, of Louisiana, a member of the Senate Committee on the Census, a memorial representing the wishes of the Association and the demands of public health workers generally, it is believed, in the matter of improved methods of collecting mortality statistics. Following is the full text of the memorial, to which have been added some of the signatures which reached Washington following its presentation, but nearly all of which arrived in time to be submitted to the conference:

RESOLUTION AND MEMORIAL OF THE AMERICAN PUBLIC HEALTH ASSOCIATION.

The following resolution and memorial were presented to the U. S. Senate on Monday, February 20, 1899, by Senator S. D. McEnery, of Louisiana:

COLUMBUS, OHIO, February 13, 1899.

To Whom It May Concern:

This is to certify that at a meeting of the American Public Health Association, held in Ottawa, Canada, September 27-30, 1898, the following resolution was adopted:

Resolved, That the American Public Health Association earnestly recommends that a plan be incorporated in the act to provide for the taking of the next United States Census whereby reliable representative vital statistics may be secured for the non-registration States.

Attest: C. O. PROBST,
Secretary.

To the Honorable Senators and Representatives of the United States in Congress Assembled:

The undersigned, members of the Committee on Demography and Statistics in their Sanitary Relations of the American Public Health Association, and other members thereof, being, for the most part, executive officers of our several State and municipal Boards of Health, and as such charged with the practical administration of the laws relating to the collection and compilation of vital statistics, as well as with the use of such statistics, in the prevention and restriction of diseases as an essential part of the public health service, have the honor to respectfully present the following statements and recommendations relating to the collection of mortality statistics by the U. S. Census:

The collection of accurate mortality statistics for the "non-registration states" is absolutely necessary to make the statistics of mortality of the United States as a whole, and of the individual states, of value for general comparative and practical sanitary purposes. These states comprised all of the States of the Union at the Eleventh Census, except Massachusetts, Connecticut, New Hampshire, Vermont, Rhode Island, New York, New Jersey and Delaware, and the District of Columbia, which had "fairly complete" registration of deaths during the census year. (Eleventh Census, Part I.—Vital and Social Statistics, page 1.) Only two or three more states will be available as "registration states" in 1900 than in 1890, so that the task of obtaining reliable mortality statistics for the country at large will fall, as before, upon the census.

The eleventh census, like its predecessors, failed entirely in establishing the general death-rate of the country. It did not even satisfactorily determine whether the mortality of the country was greater or less in the census year 1890 than in 1880:

"The total number of deaths reported as having occurred in the United States during the census year is 875,521, giving a death-rate of 13.98 to the thousand of living population. This death-rate is lower than that given in the census of 1880, viz., 15.09, and higher than that given by the census of 1870, viz., 12.77. This does not indicate any actual change in the death-rate, but rather that the enumerators' returns of the eleventh census are more deficient as regards the deaths than was the case in 1880." (Compendium of the Eleventh Census, Part II, page 3.)

The failure was, of course, even more complete as regards the non-registration states than for the country as a whole, under the last census:

"The actual death-rate for the non-registration area in 1880, as based upon the enumerators' returns, was 13.42 per 1,000 of population, while the same class of returns now give a rate of but 10.79 per 1,000; hence there must have been either a great increase in the healthfulness of the country or the enumerators' returns must be more incomplete as regards the deaths than they were in 1880." (Compendium of the Eleventh Census, Part II, page 4.)

The results of the method of enumerating deaths, at the close of the census year, have been recognized as extremely unsatisfactory ever since their first employment under the seventh census:

"The tables of the census which undertake to give the total number of births, marriages and deaths in the year preceding the first of June, 1850, can be said to have but little value. Nothing short of a registration system in the states will give these data with even approximate truth; and, where such a system has been best established, difficulties have continually occurred, requiring a very long period of time to be removed. Against all reasonings, the facts have proved that the people will not, or cannot, remember and report to the census taker the number of such events, and the particulars of them, which have happened in the period of a whole year prior to the time of his calling." (Seventh Census of the United States, 1850, page 39.)

"It is manifest that neither in 1850 nor in 1860 was the entire mortality of any state ascertained and reported; nor was even such an approximation obtained as will permit any reliable calculation to be made of the rate of mortality, or any safe estimate of the proportion of the deaths to the living. The proportions of the deaths reported in 1850 and in 1860 vary so widely—from over two per cent. to less than one-half of one per cent.—that not even the amount of deficiency can be estimated." (Eighth Census of the United States, 1860; Mortality and Miscellaneous Statistics, page 25.)

"At no one of the three censuses taken under the act of May 23, 1850, has the aggregate number of deaths returned by the assistant marshals risen above two-thirds of the number of deaths probably occurring during the year of enumeration." (Ninth Census of the United States, 1870; Vital Statistics, page 9.)

"The fact that it is impossible, in any large community, to collect complete and reliable data with regard to births and deaths by means of an inquiry made only at the end of the year for which the data are desired, is well known to all who are practically familiar with the subject of vital statistics; and the experience of the United States census furnishes no exception to this rule. The results of each of the four censuses in which an attempt has been made to ascertain the number of persons who died in the United States during the preceding year, have shown that the enumerators did not obtain and record more than 60 to 70 per cent. of the actual number of deaths; and the introductory remark to the vital statistics of mortality of the ninth census still holds good, viz.: That if the value of the statistics of mortality in a census of the United States, taken under existing laws, depended upon the return of substantially the whole body of deaths occurring during the year covered by the enumeration, the results would not be worth the space occupied by publication, much less the expense of collection and

compilation." (Tenth Census of the United States, 1880; Mortality and Vital Statistics, Part I, page 11.)

This discredited method, which has thus proved a failure for five successive United States censuses, is the method solely provided for the non-registration states, and thus for the United States as a whole, in the bills (S. 4545 and H. R. 11815) under consideration by the present Congress. The experience of the past has been conclusive as to its futility, and the failure to present accurate, and also timely, mortality statistics for the country is fraught with great injury to the sanitary service of the states. Reliable mortality statistics are essential in practical public-health work.

It is perfectly practicable, within the reasonable limits of expenditure by the census for this purpose, to collect accurate mortality statistics for the non-registration states; or, if the unreliable method of enumeration at the end of the year be retained, as at present provided by the bills referred to, then it is also even more feasible to provide for accurate registration in representative areas of the non-registration states, to the end that the amount of deficiency in the returns obtained by enumeration may be approximately known, and thus the data be rendered available for important comparisons.

To this end, the American Public Health Association, at its last annual meeting, and after the subject had received a year's consideration from the executive committee, unanimously adopted a resolution "earnestly recommending that a plan be incorporated in the act to provide for the taking of the next U. S. census whereby reliable representative vital statistics may be secured for the non-registration states."

In pursuance of the expressed desire of the Association, and in behalf of the practical collectors and users of vital statistics included in its membership, we therefore respectfully petition that general authority for the collection of reliable mortality statistics for representative areas of non-registration states, if not for non-registration states as a whole to the entire disuse of the obsolete method of enumeration at the end of the year, be incorporated in the organic census law to be passed by Congress, and that all provisions limiting the collection of mortality statistics of a reliable character solely to registration areas be stricken out.

Inasmuch as the beginning of the census year 1899-1900 is near at hand, and as the collection of reliable mortality statistics requires constant supervision during the registration year, it would be very desirable that the mortality statistics to be collected by the twelfth census should be for the calendar year 1900, instead of for the year 1899-1900. This would not only give the necessary time for preliminary organization of an efficient registration service, as part of the general census work, but would render the mortality statistics more comparable with (1) the statistics of states, cities and foreign countries, most of which are taken for the calendar year; and (2) with the population, as obtained by the census, for the very important purpose of computing death-rates. The advantage of basing rates upon the mean population of the registration year, instead of the population at the end of the year, as has been done by previous censuses, clearly appears in the following extracts from the mortality and vital statistics of the Tenth Census, Part I, page 19:

"Still less is it possible to make useful comparisons of these death-rates with those of other countries. They are in every case too small, for two reasons: The first is the failure to record all of the deaths which occurred during the census year; the second is that the calculations are based, not on the mean population of the year, that is to say, the number of living persons who actually furnished this number of deaths, but upon the number of survivors at the end of the year, which is greater than that of the mean population, and therefore gives a less death-rate. With the exception of the life-table computations, to be referred to hereafter, all the calculations of death-rates in this report and in the tables are based on the number of survivors at the end of the year, instead of taking the mean population, as is the rule in the statistics of other countries."

These representations are made with the confident belief that Congress will share our conviction that it is vastly important that the mortality statistics to be obtained under the approaching Federal census shall be accurate, and with the hope that the expression of our opinion, as practical sanitary and registration officials, whose every-day concern is the collection and use of such data, that it is entirely feasible to collect thoroughly reliable and useful mortality statistics for the United States, may have a special value at this time, and lead to the incorporation of the necessary provisions in the pending legislation.

In conclusion, referring to the purpose expressed in the bills now before Congress that the work shall be completed at an early date, we wish to most heartily commend this purpose. It will add in a very marked degree to the usefulness of any mortality statistics collected by the census to have them promptly available for use. Indeed, by the adoption of a modern method of registration, reliable statistics might be available within sixty days after the beginning of the registration year. Ample postal facilities should be at the disposal of the census, in order to secure proper returns. With proper provisions for the collection of reliable representative mortality statistics in non-registration states, we shall have made a beginning of placing our country on a plane in this respect similar to that occupied by most civilized nations, and a firm foundation will have been laid for sanitary improvement during the coming century. Respectfully submitted,

The Committee of the American Public Health Association on Demography and Statistics in their Sanitary Relations.

CRESSY L. WILBUR, M. D., *Chairman*,
Chief of Division of Vital Statistics, State Department, Michigan.

H. M. BRACKEN, M. D.,
Secretary of State Board of Health and Registrar of Vital Statistics, Minnesota.

CHAS. V. CHAPIN, M. D.,
Superintendent of Health and Registrar of Vital Statistics, City of Providence, Rhode Island.

A. G. YOUNG, M. D.,
Secretary of State Board of Health and Registrar of Vital Statistics, Maine.

JOHN S. FULTON, M. D.,
Secretary of State Board of Health and Registrar of Vital Statistics, Maryland.

This memorial has received the indorsement of the registration services of many states, not all of which were at hand in time for presentation by Senator McEnery on the date of introduction of the memorial, but most of the following were in his hands within a few days thereafter, and before the final action of the conference committee on the census:

INDORSEMENTS.

We have read the preceding memorial addressed to Congress by the Committee of the American Public Health Association in behalf of improved methods of collecting mortality statistics by the Twelfth United States Census, and cordially indorse the same:

NAME	STATE OR CITY	OFFICIAL TITLE
U. O. B. Wingate, M. D.	Wisconsin	Secretary State Board of Health
F. M. Schulz, M. D	Milwaukee, Wis	Health Commissioner
J. W. Coon, M. D.	Milwaukee, Wis	Registrar of Vital Statistics
Alex. J. Stone, M. D.	St. Paul, Minn.	Commisioner of Health
Chas. D. Smith, M. D.	Maine	President State Board of Health
Gardner T Swarts, M.D.	Rhode Island	Secretary State Board of Health
Henry B. Baker, M. D.	Michigan	Secretary State Board of Health (Ex-President American Public Health Association)
Samuel W. Abbott, M.D.	Massachusetts	Secretary State Board of Health
J. H. Hamilton, M. D.	Vermont	Secretary State Board of Health
Irving A. Watson, M. D.	New Hampshire	Secretary State Board of Health
Chas. A. Lindsley, M. D.	Connecticut	Secretary State Board of Health (Ex-President American Public Health Association)
C. Hampson Jones, M. D.	Baltimore, Md	Commissioner of Health and Registrar of Vital Statistics
Richard H. Lewis, M. D.	North Carolina	Secretary State Board of Health
H. B. Horlbeck, M. D.	Charleston, S. C.	Health Officer and Secretary Board of Health. (Ex-President American Public Health Association)
James Evans, M. D.	South Carolina	Secretary State Board of Health
J. N. McCormack, M. D.	Kentucky	Secretary State Board of Health
J. N. Hurty, M. D.	Indiana	Secretary State Board of Health
C. O. Probst, M. D.	Ohio	Secretary State Board of Health
Benj. Lee, M. D.	Pennsylvania	Secretary State Board of Health
Jas. V. P. Turner, M. D.	Philadelphia, Pa	Registrar of Vital Statistics
J. A. Egan, M. D	Illinois	Secretary State Board of Health
A. P. O'Brien, M. D.	San Francisco, Cal.	Health Officer
W. P. Mathews, M. D.	California	Secretary State Board of Health

Many other names could have been added, had time permitted, and the committee would most earnestly deprecate the assumption of any intention to slight any of the prominent sanitarians and officers of state and municipal boards of health who would have been pleased to add their indorsements. Only a little over a week elapsed from its formulation until it was presented in Congress, at the last available moment,

and the securing of such a body of representative signatures in that time required rapid action. We believe that the sentiment of the practical workers in vital statistics in this country is practically unanimous on the points covered in the memorial.

As it is, the indorsements represent the public health services of no less than eighteen states, with an aggregate population of 31,610,676 persons according to the last U. S. Census, or over 50 per cent. of the total population of the country. They include most of the registration states, and show in a striking manner the feeling prevalent among the sanitarians and practical registration officials of the country in regard to the continuance of the futile and discredited methods of the past in the collection of mortality statistics by the next census.

While immediate success has not crowned the efforts of the Association in this direction, it has placed itself definitely upon record as an advocate of improved methods in collecting the mortality statistics of the census, and has made a beginning of an important work which should go forward until the desired results are obtained. The movement should gather momentum year after year, until by the time of preparation for the next census a mass of well-arranged and conclusive arguments shall be presented with the whole force of the Association, and the needed reform be brought about. Much education is necessary, as may be inferred, of the members of Congress, who are inclined to slight the subject of vital statistics as a relatively unimportant one in comparison with the entire scope of the census. Iteration and reiteration of the importance of reliable vital statistics for this country, with demonstrations of the worthless character of the data collected by the censuses—for which the Twelfth Census, now in process of organization, will afford an excellent *corpus vile*—will in time make an impression on the rock of Congressional ignorance and indifference, and the United States will take an equal place among the civilized nations of the world in this respect, one to which she is not entitled at present.

THE SUCCESS OF THE MOVEMENT FOR A UNIFORM CLASSIFICATION OF CAUSES OF DEATH.

Resolved, That the American Public Health Association recommends that the Bertillon classification of causes of death be adopted by all the registrars of vital statistics in the United States, Canada and Mexico, as soon as the change from the systems now in use can be conveniently made.

Resolved, That the Committee on Nomenclature of Diseases and Forms of Statistics (now the Committee on Demography and Statistics in their Sanitary Relations) be authorized to have printed and circulated among the registrars of the three countries, a circular containing these resolutions, the report of the committee on which they are based, the three alternative forms of the Bertillon classification, with explanatory

notes on inclusion of terms and practical rules for compilation, and a list of the registration offices adopting the same.

Resolved, That a proposal be made for an international alliance between the registrars of the three countries included in this Association, and the registrars of France and other countries now using, or which shall hereafter adopt, the Bertillon system, and that definite plans for such alliance shall be submitted for action to the next annual meeting of this Association.

With the recommendation of the Bertillon classification for use in the countries recommended in this Association, according to the resolution adopted last year, the committee considered that the question was settled so far as the individual states and cities of the United States were concerned. Some states and cities (*e. g.*, Vermont, Michigan, Baltimore, Milwaukee, Toledo, Savannah, etc.), have already put the system into use, while others (among them Greater New York), in accordance with the recommendation of the committee, have deferred its adoption until after the revision of 1900. The time is short to wait, and the revised version will undoubtedly be more satisfactory in some important respects.

A pamphlet of 40 pages has been prepared and widely distributed. It contains an exposition of the Bertillon classification based on the latest French edition (1898). Thanks are due to the medical press of the country for kindly publishing announcements in regard to the same, thereby calling the attention of physicians, sanitarians, pathologists, and others to the proposed revision.

Besides the pamphlet issued by this committee, the Canadian Commission published shorter pamphlets, in both English and French, and the Mexican Commission has recently prepared a complete translation in Spanish, which should be of great use in the countries of South and Central America.

The committee began correspondence with the registration offices of South and Central America, as well as some elsewhere, immediately after the definite adoption of the classification by the Association. Most gratifying assurances of approval have been received, and the entire Western Hemisphere, including North, South and Central America, may probably be counted for the Bertillon classification. The Argentine Republic has long used the system (since 1891) in Buenos Ayres, its chief city and the metropolis of South America. It is used in the progressive government of Uruguay. The Republic of Colombia has recently by official decree, after careful investigation by the Faculty of Natural Sciences and Medicine, adopted the system and will send a Commission to the Revision of Paris. Costa Rica early adopted the classification, and probably other countries of Central America could have been announced had not the unsettled condition of

political affairs prevented. The only evidence of retrogression—the only country in the world that has ever adopted and then rejected the Bertillon classification—is in the case of Brazil. This, indeed, is probably not so serious a defection as it might seem, for the system of local origin which was lately adopted is not widely different, and there is still a hope that the Brazilian government will be represented in the Revision of Paris and will decide to agree with the other leading countries in this matter. If there are still some countries not included, it should be remembered that in many parts of South America there are practically no statistical organizations. As fast as these are constituted, with its prestige and extensive prevalence, both in English and Spanish speaking countries, there can be no doubt of the final complete adoption of the Bertillon system.

The progress of the system in Europe has also been very satisfactory. The revision will be conducted under the auspices of the International Congress of Hygiene and Demography at Paris next year, and until that has been completed, the formal adoption of the system by certain European governments cannot be expected. Nevertheless, even at this early date, it has been accepted by the kingdoms of Greece and Holland, will probably soon be adopted by Belgium, is used in the kingdom of Würtemburg and Duchy of Hesse, Germany, and is employed in quite a number of cities, among them Madrid and Barcelona, Spain; Oporto, Portugal; Budapest, Hungary, and Vienna, Austria. It has been used in Moscow, Russia, since 1892. At the recent meeting of the municipal registrars of the German Empire at Königsberg, it was carefully considered and referred to a special commission, in order to reconcile some points of difference with the system formerly adopted. Several pamphlets by eminent European statisticians, among them Dr. Korösi and Dr. Altschul, have appeared on the subject.

THE PLAN OF DECENNIAL REVISION.

Resolved, That the American Public Health Association approves the general principles and plan of procedure relative to the periodical revision of the Bertillon classification of causes of death as submitted by the Committee on Demography and Statistics in their Sanitary Relations.

Resolved, That commissions of three members be appointed by the President of the American Public Health Association at this meeting, subject to the approval of the Executive Committee, from each of the countries represented in the Association, to act jointly with each other and with similar commissions from other countries in the revision of the Bertillon classification of causes of death; and that said commission shall be authorized to adopt such necessary rules, in conjunction with other countries associated in the work of revision, as shall be necessary for its successful conduct; they shall report progress to this Associa-

tion at each annual meeting, and shall be continued until the work of revision is completed and their successors selected for the next periodical revision.

The plan proposed by this committee at the last meeting of the Association has met with general approval, so far as known. Following are the resolutions adopted by the International Statistical Institute at its recent meeting at Christiana, Norway, September 4-9, 1899:

THE INTERNATIONAL STATISTICAL INSTITUTE,

Convinced of the necessity of employing a comparable nomenclature in the different countries,

Recognizing with pleasure the adoption by all of the statistical administrations of North America, by a part of those of South America, and by a part of those of Europe of the system of nomenclature of causes of death which was presented to them in 1893.

Insists urgently that this system of nomenclature should be adopted in principle, subject to revision, by the statistical offices of all of Europe;

Approves, in its general outlines, the system of decennial revision proposed by the American Public Health Association at its session at Ottawa in 1898;

And requests the statistical administrations which have not yet adhered to it, that they should do so without delay and contribute to the comparability of the nomenclature of the causes of death.

It may well be a source of pride to this Association that the foregoing expression of the International Statistical Institute, which heralds the way to the world-wide prevalence of a uniform nomenclature of causes of death, would probably not have been possible if it had not been for the definite action of this Association in indorsing the classification last year at Ottawa. The prestige which it thus gained in America has reacted and beneficially influenced its progress in Europe, and we have now only to wait until the consensus of European registrars shall have ratified and adopted the principles which have been accepted by the registrars of the western world.

While the announcement of the approval by the International Statistical Institute of the plan of revision proposed by this Association is very gratifying, and while the preliminary work of revision has proceeded very satisfactorily under this plan, at least for the countries embraced in this Association, it should not be forgotten that no attempt was made to legislate in any hard and fast lines upon this matter, and it may be quite possible, considering the short time before the date of revision, that some other arrangement may be desirable, at least in some special cases. It is recommended that the several commissions working under the auspices of this Association consider themselves governed only by general principles, and that they be free, during the

session at Paris, to join in any equitable plan which seems calculated to promote the fullest and freest union of all countries interested.

With the publication of the pamphlet on the Bertillon classification, the final duty of this committee with reference to the matter has been discharged, and the future progress of the work may be followed in the reports of the commissions for Canada, Mexico and the United States, which will be presented to this Association at this meeting and annually hereafter. The adoption of a uniform classification is not the ultimate end of statistics, but is simply a preliminary step in order that international comparisons may be made. Other reforms are of quite as much importance, but are properly secondary in order of time. After agreement has been reached in regard to the individual terms of the schedule of causes of death and their inclusion, then we can proceed to define in what manner, as regards age and sex incidence, etc., they shall be statistically treated. But without the preliminary agreement on the primary terms and their meaning, all comparisons are vitiated.

ADOPTION OF THE BERTILLON CLASSIFICATION BY THE CENSUS.

Resolved, That the governments of the United States, Mexico and Canada be likewise requested to make this classification the basis of the mortality statistics of the censuses of 1900 and 1901.

It is yet too early to learn what action will be taken in regard to the adoption of the Bertillon classification by the census authorities of Canada and Mexico for the censuses of 1901, although it is believed that it will be favorable. It is also early to learn the action of the Twelfth U. S. Census, but, as shown by the following correspondence, the subject is under consideration, and we trust that the result will be favorable. Certainly, if the registrars of the country, who have already adopted the Bertillon classification, and the large number who are about to do so as soon as the revision has been completed, will call the attention of the Census Bureau to the advantages which will result in internal comparisons if the census follows the states in adopting this uniform system, the result will not remain in doubt. It is only to be hoped that if adopted, it be adopted as a whole, and no peculiar modifications be introduced to interfere with ready comparisons.

LANSING, MICHIGAN, August 22, 1899.

Hon. Wm. R. Merriam, Director, United States Census, Washington, D. C.:

DEAR SIR—I have the honor to submit to you a certified copy of resolutions adopted by the American Public Health Association, relative to the Bertillon classification of causes of death, and desire to call special attention to the resolution specially marked, asking that the

Governments of the United States, Mexico and Canada be requested to make this classification the basis of the mortality statistics of the censuses of 1900 and 1901.

I am now preparing the report of the Committee on Demography to the American Public Health Association, at the session to be held in Minneapolis early in November, and shall be very glad if you can inform me as early as convenient in regard to the adoption of this system of classification by the twelfth census.

Thanking you in advance for your kind compliance with this respect, I am, Yours very respectfully,

CRESSY L. WILBUR,

Chairman, Committee on Demography, American Public Health Association.

WASHINGTON, D. C., August 25, 1899.

Dr. Cressy L. Wilbur, Division of Vital Statistics, Department of State, Lansing, Michigan:

DEAR SIR—I have the honor to acknowledge receipt of your letter of the 22d instant, transmitting certified copy of the resolutions adopted by the American Public Health Association, requesting that the Bertillon classification be made the basis of the Mortality Statistics of the Twelfth Census.

In reply I would say that the question of the classification of the causes of death to be used in the census reports cannot be properly decided at this time. The return of deaths obtained from registration sources will be for the calendar year 1900, and as the work of transcription will not be commenced until January, 1891, [1901?] there is plenty of time for consideration of the matter.

There are many reasons for a revision of the classification given in the previous reports, and the Bertillon classification seems, so far as I have examined it, to be admirable, but for the country as a whole our principal comparisons are with the English statistics using the classification of the Royal College of Physicians, and I do not now see that the change can be made so as to preserve the desired comparibility. Possibly by the time a decision is necessary the English Registrar General may adopt the Bertillon system, which would simplify the matter. Respectfully,

W. A. KING, Chief Statistician.

LANSING, MICHIGAN, August 28, 1899.

Hon. W. A. King, Chief Statistician, United States Census, Washington, D. C.:

DEAR SIR—I have your letter of the 25th instant, relative to the adoption of the Bertillon classification of causes of death, and am glad to note your general approval of the system.

There is no special urgency in its practical adoption and I hope you may in any event submit a list of any desirable changes so that they can be considered in the work of revision.

As you are aware, a commission, acting under the auspices of the American Public Health Association, is now engaged in obtaining information relative to changes desired by the registrars of this coun-

try in the system of classification, the results of which will be definitely acted upon by the International Commission of Revision, to be held at Paris next year, in connection with the Congress of Hygiene and Demography.

Whether the census adopts the Bertillon classification or not your suggestions will be warmly welcomed and will be given full consideration in the revision.

I note what you say in regard to the comparability with the classification employed by the English Registrar General. I do not think that there is any present prospect of the adoption of the Bertillon classification by England or by the majority of her colonies. In fact, in correspondence with registrars of some English colonies, I have deprecated any change from their present system of uniformity with the mother country. From this statement I except Canada, which I am glad to say, for geographical reasons, has joined with the United States and Mexico in using the Bertillon system.

There is room for two somewhat different systems in the world with very little disadvantage in comparing the statistics, and I think that the individual items of the English and Bertillon systems will be found to be readily comparable in most cases. Of course, the groups are somewhat different, but this has little practical importance, since the tendency is now to pay little attention to the groups or classes of diseases.

The great advantage of the adoption of the Bertillon classification by the census would be the fact that the data would be directly comparable with the registration reports of the registration states, and with those of many states not classed among the registration states, on and after the year 1900. All of the registration states, Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New Jersey, Delaware and Michigan, with the single exception of New York, have definitely accepted the Bertillon classification, to be put into practical use as soon as the revision is completed and announced. That is, the first year under this system will generally be 1900 or 1901. I may say also, in regard to the State of New York, that I am inclined to believe that it will agree with the other registration states in this matter. The city of New York has adopted the classification and would have made arrangements to put it into practical service, beginning with the year 1900, if Dr. Tracy had not concluded on my suggestion to wait a year longer for the revision.

I have had some correspondence on this subject with Professor Willcox, but do not know the exact prospects or the grounds for delay. Still, I think New York will accept the classification, and, even if she does not, it seems to me that the uniformity of the census with all of the other registration states would greatly outweigh any advantage to be derived from maintaining strict conformity with the English classification.

I hope that on further consideration you may find it proper to join with the state registrars in this matter, as I note by your circular that the government is desirous of inaugurating a uniform scheme of mortality registration. Uniformity in the nomenclature of causes of deaths lies as the basis of many other reforms necessary for uniform mortality statistics, and the agreement of the general government with the states

in this matter would pave the way for the agreement of the states with the general government in many of the details of registration.

I hope you may be present at the meeting of the American Public Health Association, to be held at Minneapolis, October 31 to November 3, 1899. I am now writing to members of the Committee on Vital Statistics, and other vital statisticians, asking for papers on subjects relating to registration work, and should be greatly gratified if you would present some paper on such subjects. There is generally a large attendance of state and municipal registrars at these meetings, and I believe that a paper on the relations of the general government to state and municipal registration would be highly appreciated and would be of service to the census work.

Yours very truly,

CRESSY L. WILBUR, Chief of Division,

Chairman, Committee on Vital Statistics, American Public Health Association.

WASHINGTON, D. C., August 31, 1899.

Dr. Cressy L. Wilbur, Chairman, Committee on Vital Statistics, American Public Health Association, Lansing, Michigan:

DEAR SIR—I have received your letter of the 28th inst., and in regard to the meeting of the American Public Health Association, I have to thank you for your kind invitation to participate. I fear, however, that the work here will not permit me to do so. I wish to complete the correspondence in relation to the registration records and after that to arrange for the subdivision of a number of the larger cities into sanitary districts, and this latter work will be in progress about the time of the meeting.

I note what you say in regard to the Bertillon classification and agree with you to a very large extent. Am particularly glad to know that you are of the opinion I have always entertained that the classification of diseases is of little practical importance if the individual causes are given in sufficient detail to permit any desired grouping to be made for special reasons.

I have not yet had time to examine very carefully the classification as contained in the pamphlet, which you so kindly sent, but hope to be able to take it up before long and I may then communicate with you further.

Very truly yours,

W. A. KING, Chief Statistician.

It was by no means intended to convey the impression that the classification of causes of death was of little practical importance, for it is of the greatest practical importance; but the idea was rather that it was important as a means to an end, rather than that the arrangement and terminology were in themselves of special interest.

CONCLUSIONS AND RECOMMENDATIONS.

With the completion of the work relative to the nomenclature of causes of death, a larger part of the time of the Association should be devoted to other subjects of vital statistics, which have been necessarily

neglected to some extent in recent meetings. Technical papers, dealing with the best methods of collection, tabulation and presentation of vital statistics, should be presented, but papers of a different class, relating rather to the employment of vital statistics in practical sanitary administration, should also have consideration.

The resolution relating to the collection of reliable representative statistics by the U. S. Census in non-registration states should not be suffered to lapse, but should be urged until the desired end has been obtained.

So also in regard to the adoption of a nomenclature uniform with that of the states by the U. S. Census. The work of the Commissions of Revision acting under the auspices of this Association, should be sustained, and some provision should be made for the issue of a revised version, for the use of the states, provinces and cities represented in this Association, as soon as the revision shall have been completed.

Some systematic effort should be made to extend the number of registration states, and to insure that all states and cities adopting methods of registration shall comply with certain necessary standards of efficiency, which it might well be the province of the authorities connected with this Association to formulate for convenient reference.

Lastly, no efforts should be spared to raise the general standard of vital statistics, and to increase their value in the public mind as an absolutely essential part of modern sanitary science, and the basis of public health work. Vital statistics should be systematically taught in our medical schools, with special reference to their practical use by health officers and students of the prevalence of disease. The practical study of vital statistics, and especially mortality statistics, is a necessary and honorable part of the work of the medical officer of health, and its reputation and character should not be diminished by withdrawing it, in any case, from medical direction. Respectfully submitted,

CRESSY L. WILBUR,
CHARLES V. CHAPIN,
A. G. YOUNG,
H. M. BRACKEN,
JOHN S. FULTON.

REPORT OF THE COMMISSION OF REVISION OF THE BERTILLON CLASSIFICATION OF CAUSES OF DEATH ACTING UNDER THE AUSPICES OF THE AMERICAN PUBLIC HEALTH ASSOCIATION.

REPORT OF UNITED STATES COMMITTEE.

MR. PRESIDENT AND MEMBERS OF THE ASSOCIATION—The work of the Commission began with the receipt of suggestions for amendments to the present form of the classification, in response to the request for such suggestions and the pamphlet circulated among the registrars, pathologists, statisticians, and others interested, in the country, by the Committee on Demography and Statistics in Their Sanitary Relations. These suggestions have been fairly numerous, have come from sources of high character, and have fairly covered the ground of desirable changes, as especially needed in connection with the tabulation of mortality statistics in this country. All of the suggestions made have been printed in the *Michigan Monthly Bulletin of Vital Statistics* for August and September, 1899, and copies of the same have been transmitted to the Secretaries of other National Commissions, agreeable to the plan of procedure adopted by the Association,

The next step in the work of revision will be to add the suggestions received from foreign sources to those collected in this country, and to submit the whole to the registrars of the United States for an expression of their opinion as to the desirability of adopting each one of them. This is to be done by December 31, 1899.

After the returns from the registrars shall have been made, the Commission will tabulate them, and present them at the session of the International Commission, held in connection with the International Congress of Hygiene and Demography at Paris next year.

It is gratifying to know that the International Statistical Institute, at its recent session held at Christiana, indorsed the general plan of revision recommended by this Association and under which this Commission is constituted and is at present working. Its practical acceptance by France, Colombia, Costa Rica, etc., in addition to three countries embraced in this Association, would also seem to promise well for its feasibility as a method of procedure at Paris. Should, however, any unforeseen causes prevent its general adoption, then it is urged that the Commissions for Canada, Mexico and the United States appointed by this Association be left entirely free to unite with the representatives of other countries in any other equitable manner that may be found advis-

able. In a practical question of important work to be done, and to be done with promptness in order that the results may be ready for use with the coming century, no trivial questions of forms of procedure should be suffered to stand in the way of a hearty agreement, to which, indeed, very many of the countries in the world seem most favorably disposed.

The work of collating the opinions of American registrars is especially difficult from the fact that we have no national registration bureau; hence the individual registration States and the registration cities in non-registration States must be consulted. It is recommended that a small allowance be made for the necessary expenses of printing, postage, etc., to complete the work up to its submission to the International Commission.

Correspondence on the progress of the work has been conducted with the Canadian, Mexican, Costa Rican, French, and other foreign Commissions, and we take great pleasure in communicating to this Association the compliments and assurances of the most devoted respect of the proposer of the classification, Dr. Jacques Bertillon, Secretary of the French National Commission.

Respectfully Submitted,

SAML. W. ABBOTT,
A. G. YOUNG,
CRESSY L. WILBUR.

REPORT OF THE CANADIAN COMMITTEE.

The following telegram was received from the committee representing Canada:

MONTREAL, QUE., Oct. 30, '99.

Dr. E. P. Lachapelle,
Hotel West, Minneapolis, Minn.:

Canadian committee reports progress. It has received one suggestion from Nova Scotia board, and five from Quebec provincial board. Suggestions are expected from Ontario, Manitoba and British Columbia before making final report.

E. PELLETIER.

REPORT OF THE MEXICAN COMMITTEE.

Since the month of January, 1896, the statistical tables of mortality, which are formed by the Supreme Board of Health of Mexico, have been adapted to the nomenclature of the causes of death, which were proposed by Dr. Jacques Bertillon and accepted by the International Institute of Statistics. This nomenclature was put in force on motion of the members, Drs. Eduardo Licéaga and Nicolas R. de Arellano,

who presented a favorable report on the subject on the fourteenth of December, 1895.

This report stated that in Mexico, it would not be possible to fill up the group which corresponds to number 142 in the first nomenclature, 142A, to 142H of the last, which covers the different classes of suicide, because the office which collects the data relative to the deaths in the City of Mexico cannot always furnish the Board with those relating to the cause of death, when it is caused by accident or violence.

As the nomenclature in question is vague in its definition of abortions and premature births, the Board in adopting it, excluded the headings that correspond to these causes, in the formation of statistical tables, and decided that these figures should be added outside of the tables, because although they have only a slight importance as regards statistics, they are of importance as regards hygienic studies.

Up to the present we have been employing this system of nomenclature in the mortality tables of the municipality of Mexico, and in compliance with the provisions of Art. 51 of the Sanitary Code of the United States of Mexico, now in force, the Board proposes to make it known to all the States of the Republic, in order that it may be adopted in that part which corresponds to the medical statistics and also with the object of procuring uniformity in this class of work throughout the country, so that the data obtained can be compared with each other and therefore lead to practical conclusions in matters.

I have the honor to forward with this letter some copies of the "Nomenclature of Diseases (causes of death—causes of incapacity for work)," by Dr. Jacques Bertillon, which nomenclature has been adopted by this Board for its tables of statistics of mortality in the City of Mexico, and approved by the Department of the Interior.

Article 48 of the Sanitary Code of the United States of Mexico requires the issue of medical certificates of the deaths that take place in accordance with the respective model as issued by the above department. The object of this legal provision can only be that of registering the death and the disease that caused it in the registry office, so that this entry will serve together with the others made in accordance with the law, for the formation of the most perfect statistics possible as to the causes of death.

It is therefore of great importance to obtain uniformity throughout the Republic, in the methods for collecting these data, and for this purpose, I take the liberty of recommending, that if you consider it advisable, you should order the reproduction of such nomenclature in the official organ of your State, and if possible, in a special pamphlet in order that it may be known by physicians and that the employes of

the registry office may prepare their statistics in accordance with the same.

In order to further facilitate this work, I also take the liberty of enclosing a blank certificate of death as issued in the Federal District, and which can be adopted by your government with the corresponding modifications, for the purposes specified in the above mentioned Art. 48 of the Sanitary Code, until the Executive of the Union considers that after these preparatory measures, the proper moment has arrived for ordering that uniformity be established in the statistics of mortality relating to public health.

The Mexican Committee which was appointed by the meeting of the American Public Health Association, held at Ottawa, Canada, from the 27th to 30th of September, 1898, and commissioned to procure the adoption of the Bertillon nomenclature, and also confer with the Canadian and United States Committees as well as with those of other countries for the purpose of a periodical revision, at once commenced the work of translating it into Spanish, so as to obtain its circulation, not only in this country, but also in all the Spanish-American nations who are interested in the question, and the Mexican Committee is also making a study of the reforms that could be introduced in that nomenclature for the purpose of presenting them to the International Revising Committee, which will meet in Paris in the year 1900.

José Ramirez, M. D.,

General Secretary of the Supreme Board of Health of Mexico.

August, 1899.

METHODS OF COMPILATION USED IN PREPARING CENSUS AND REGISTRATION REPORTS.

By Dr. GARDNER T. SWARTS,

Secretary State Board of Health of Rhode Island.

Owing to the increased interest in vital statistics evinced by one of our western states, and the stimulus given to other states by the zealous agitation of the subject, by its earnest registrar, I have been requested by the President of the Association to present such facts as are available as to the various methods at present in use, for the computation, or compilation, of the data to be found in the return, or certificate, of death.

From the earliest times, a record of successive incidents of the same kind was kept by means of markings, and varied signs, upon parchment, tile, or stone. The aborigines of this country were in the habit of keeping their record hanging at their belt, in the form of scalp-locks, taken from their victims, while the earlier settler recorded his mortality statistics of aborigines destroyed, by notches cut into the stock of his gun.

At the present time, with the ready means afforded by the use of plumbago, inks and paper, the simplest form of notation has been what is called, "the dot and dash system," a successive dot or dash being set against each distinct item that the data on the return presented. These in turn are counted, and the total set against the item. A variation is made at times between the dot and the dash, or any other distinctive mark, or check, which permits of the more ready discovery of the particular bundle of returns which are successively examined.

One of the disadvantages of this system consists of the impossibility of determining which individual return has been noted incorrectly. If a failure is made to place a dot or dash, the discovery is not made until the total is made up; it then becomes necessary to do the work all over again, since the individual return which is omitted cannot be distinguished.

As an assistance, both in rapidity and convenience, in recording the tally, a self-counting, or tally sheet, was devised by Mr. Chas. F. Pidgin, who has been connected with the statistical work of the Massachusetts Bureau of Statistics of Labor for the past twenty-nine years, filling the position of Chief Clerk of that Bureau since 1876. This sheet consists of a separate line for each item, the line consisting of a series of dots, the tenth dot being larger and more distinct than the previous nine. The advantage of this form of tally sheet is that the

total may be read off at any time without counting up the number of dots or dashes. Variations of the form of dot, dash, bracket, or circle indicating the tally, may be used on these sheets to indicate different data, but which might be desirable in connection with the data first entered upon the same line, such as a different district, ward, or town.

This is more useful when the number of returns counted are small. It has the disadvantage of any dot and dash system.

In the course of his association with statistical work, and from his experience of the needs of the forms of work, Mr. Pidgin has invented and introduced many devices for facilitating the work of compilation.

The first of these was the use of the slip, or card system, upon which the whole data of the return was marked. These cards, or slips, were sorted into boxes, or racks, according to the data given upon the cards. These cards could then be counted, and if any deficiency was found in the total, the individual pack, or sort, could be quickly run through, and the missing or mistaken item found.

As an adjunct to the original Pidgin System, the trays, or boxes, receiving the cards were supplied with lids which closed automatically, by means of a stiff spring, but upon being opened, press upon a counting dial, thus giving the result of the count at the end of a sorting. This did away with counting the cards by hand.

As a part of the original system, and as a check against the introduction of a wrong card into the sort, or boxes, the record of the return was indicated by holes punched into the cards against the various data required. This punching was done by means of a hand puncher. A bunch of these when sorted would each necessarily have the same corresponding hole, and a wire being passed through this hole in the collected bunch, would meet with no resistance unless a wrong sort had been made, in which case the offending card could be withdrawn and placed in its proper division.

Improvement was next made upon the sorting boxes, by introducing into boxes a simple but effective counter which is operated by hand when the cards are sorted into their respective compartments. This form of machine, called "The Automatic Multiple Counting or Tabulating Machine," was devised and used by Mr. Pidgin in compiling the State Census of Massachusetts in 1895. This machine is operated directly from the original schedule, or return. It consists of a box having saw-tooth slits across the tin front. By lightly pressing a projecting arm, or wire, a spring throws this arm into the slots between the teeth. Each slot has a number indicated over it from one to nine. The lowest row indicates units, the second tens, the third hundreds, and the fourth thousands. When the unit arm has reached slot nine it is thrown back to zero with one sweeping motion, and the lever, or arms, of tens

is touched once, throwing it into the first notch of the tens. Thus, by the aid of this simple device, counts may be made as high as ten thousand.

A device called "The Pin Board Electrical Tabulating System" was next produced by Mr. Pidgin. This consists of a stack of 108 counting machines which automatically adjust themselves at zero as the result of simply pressing a button. These counters are erected before the operation, and are set in motion by an electrical connection which is operated from a pin board. A card having letters or characters representing the items to be recorded, is placed over the pin board, and the pin and punch are driven through the card at the items indicated. This operation causes the counters to register and at the same time produces the punched card, thus accomplishing two results with one motion.

For this pin board may be substituted what Mr. Pidgin terms, "The Electrical Typewriter Tabulator." The keys of the typewriter may be marked with transferable labels indicating the 108 items which are to be counted.

This machine is operated directly from the schedule, or return. This does away with the use of a card and with punching. Twenty-one index keys, or guides, are arranged on two sides of the keyboard which gives a guide to tabulation. By using the index, or guides, in correlation with the keys, a combination of items may be registered by the pressure of one key. In this way it is possible with one stroke to count the items of sex, nationality, color, conjugal relation, and age periods.

Mr. Pidgin claims that if this form of machine is operated even as slowly as one-half the ordinary speed of the typewriter, that 105 tables may be made per minute, or 6,300 registers per hour, or 44,100 tables per day of seven hours.

A "Multiple Adding or Chip System" has been used by Mr. Pidgin for a number of years. This system is for adding small numbers where a great number of totals are desired. Its capacity is from units to millions. Colors are used to indicate units, tens, etc. The digits are printed in large characters, the six being distinguishable from the nine. The operator selects the card numerals from the case as a type-setter would pick his type.

By this process, two hundred columns may be added at a time with only one result slip for the totals. The chips are counted after being drawn from the rack in which they are sorted. This may be done by using any of the counting devices previously described, the typewriter tabulator being the most satisfactory. As the cards are counted, they may be sorted into a sorting box near by the operator, and thus be available at once for placing in the rack from which they are first drawn.

A device similar in operation to the "Pin Board Electrical Tabulating System," but differently constructed, has been devised by Mr. Herman Hollerith, of Washington, D. C., and is known as the "Hollerith Electrical Tabulating System."

This system consists of first preparing a card of exact size and shape upon which is printed the numbers, or the letters, which shall correspond to all the data which can possibly be found upon any given return of death or schedule of census.

Inasmuch as the causes of diseases, as well as occupations, are exceedingly numerous, it is found impracticable to represent each disease by a given number, or sign, but it is feasible to indicate the several classes of causation, and to indicate by a specific number, the subdivisions of those classes.

By a specially prepared machine, these numbers, or signs, are punched out of the card for each item of the data given on a single return; this card, therefore, represents the return, reading in the form of punched holes. It is now possible to sort these cards by hand, using the punched holes as the heading, but where the number is large, the objection to the original Pidgin system in this method is not removed.

The next detail in the Hollerith System was to sort these punched cards by the use of the electrical sorting and counting device. The punched cards are placed one by one, by hand, upon a rubber slab holding as many small mercury cups as there are indications on the unpunched card. Above the slab with its cups, is suspended an equal number of needles, or wire points. The bottom of the mercury cups are each individually connected with a dial-hand operated by small electric magnets. The needles are individually connected on the opposite pole of the magnets. The card being placed on the rubber slab, the needles are all brought down at once by a single motion of a lever. Certain of the needles will drop through the punched holes in the card, come into contact with the mercury in the cups, thus completing a current through the magnet which releases the hand on the dial one point.

Each time a current is made a register of one is recorded on the individual dial which corresponds to the hole in the card, which, in turn, represents age, sex, color, conjugal conditions, etc. When the digit hand on the dial has completed a count, a second hand tallies one hundred on the dial so that a computation of ten thousand may be made on each dial.

After a certain division, or bunch of cards, representing a city or county has been passed through the tabulating machine, the totals on the dials may be read off and noted on the total tables of the report.

One dial is reserved and placed in a common count which records the exact number of cards which pass through. The total, therefore,

of any given item, as for instance in color, the total of black, white and mixed must be equal to the total on the reserved dial. By this means any failure to have punched the card for these items, or failure on the part of a dial to record, is immediately noted and the card discovered by running the bunch through and noting the total for every five or ten cards passed.

Since the number of items called for in the report may number upwards of two hundred and forty, it is evident that this number of dials, each of which is about three inches square, would occupy too much space. An electric connection is therefore made with a sorting box, which consists of a certain number, say 26, all of which have a light metal cover, which is held in place by means of an electric magnet. A sort is made by counting up each cell, or box, with the items, the primary division of occupations, or of divorces.

When the needle passes through the item hole, the contact of the needle with the mercury causes the lid, or cover, of the box to be released. A spring throws the cover wide open. The card having been on the record, is slid off by hand into the cell, or compartment, found open. The cover is then thrown into place, by hand, being caught by the hook on the electric magnet and from which it was released when the magnet moved. The opening of the sorting box, and the working of the one or more dials, operate at the same time.

The cards accumulating in the boxes are taken in their sorted bunches to the dial portion of the machine, and a record is made of the holes found in the sub-divisions of occupations, or diseases.

Although each card is placed and removed by hand, yet an operator quickly acquires great celerity and rapidity in the working of the machine. It will be noted that the operator does not read the cards, but the instrument does. The power for operation of the magnets is provided by about twenty-four carbon zinc cells.

When any sort, or bunch, consists of but few cards, they are more readily worked by hand. The limit of this method of sorting and counting varies with the operator. The reading is made by observation of the holes which correspond with the data as given in the original certificate, or return.

As a variation or simplification of the work of punching, a machine has been devised by Mr. Gore, of the Actuary Department of the Prudential Life Insurance Company, of Newark, N. J.

This consists of the union of cutting, or punching, rods with the key-board of a typewriter. In this instrument the cards are fed and expelled automatically to and from the punching blade. As a matter of economy, and for the purpose of having cards accurately cut that there may be no variation in size, which would lead to obstruction in

the several machines through which it passes, Mr. Gore has devised a machine which will automatically cut these cards from strips of cardboard distributed from a roll. These cards are also stamped automatically with a consecutive number, and printed with the letters, or signs, representing the data to be noted.

Mr. Gore's method of sorting consists in placing bunches of the punched cards in a number of hoppers which are arranged on a circular platform, several of these circular receptacles being imposed one upon the other, each being free to revolve independent of the circle above and below. In each circle there are receiving compartments in which the projecting wire is inserted at a point which will correspond with the location of the hole in the card the notation of which is desired. As these circles are readily revolved by hand, or electric motor, each successive card comes in contact with these pins, and if the hole be present directly over the pin, the card will drop into its proper receptacle; if not, it continues to revolve until it finds a point, or pin, which does correspond. In this way all of one age, or different age periods, may be sorted at the same time. These pins are adjustable in sockets for any of the signs found on the cards. In this way the sorting is done with great rapidity, many thousands being separated within an hour.

Succeeding this operation, an instrument has been devised which shall receive these cards from a hopper, and automatically *count* and register the number of cards of any individual sort placed in a hopper. As this does away with the mistakes which are liable to accrue by lack of memory of the hand-sorter, the results are more accurate. A mistake made by the hand-sorter, of passing two cards at one time, is obviated in this counting instrument, since two cards cannot enter at the same time. Any failure to enter checks the operation of the machine.

There is on the market a hand adding machine which will record single tallies, or items, or one subject, to the number of 999, the next pressure upon the projecting lever of the machine throwing the reading dials, or rather registering wheels, over again to 000, making 1,000. These counters are used by umpires of base ball and other games, by inspectors of steam-boats, and in any large assembly to tally the number of persons present.

It is a circular box of metal, about two inches in diameter, with glass center on the front, protecting the registering wheels. Each wheel may be thrown back to zero by means of thumb keys on the back. The wheels are set in motion by pressing a lever which projects on one side. This is useful only in adding by single additions of one or two.

For the purpose of adding numbers including units, tens, thousands

and upwards, a device known as the comptometer is to be found on the market. It consists of a box fourteen inches long and eight inches wide and four inches deep, containing a series of wheels, each having ten notches with a cam on each wheel at the tenth notch which will cause the neighboring wheel to advance one notch, or number. The turn of the wheel is produced by pressing upon a key button upon which is imprinted a number. There are nine digits in each vertical column of units, tens, etc. These buttons press perpendicular rods which force horizontal arms, or levers, to press against the notches on the wheel, the amount of push being governed by the length of arm or the leverage of each number. The numbers being farthest removed from the register or dial has the longest leverage. All the numbers on the dial may be brought to zero by turning a small wheel on the side of the machine.

A device for the same purpose is found in the Electrical Adding and Multiplying Machine of the Pidgin System. It differs from the previous machine by the numbers being notated by means of sliding keys instead of stiff upright keys. The keys, or arms, with pointer, are pushed up on the scale to the number to be added. All of the numbers up to a billion, being set, it is possible to read the numbers off for correction before bringing them back into place and registering on the dials.

This form of machine has the advantage of accuracy, and noiseless and easy of operation, very little effort being required to push the sliding arms into position. The only disadvantage is the necessary width of the machine. An attachment also provides for locking the machine to avoid intentional or accidental movement of the arms by some person other than the operator.

As with the Comptometer, multiplication and division and other mathematical computations may be mechanically executed with the aid of this machine.

As to the advantages of one system over the other, it may be stated that any mechanical device which will relieve the mind, the hand and the eye from continuous routine effort, will serve the avoidance of mistakes. Such devices necessarily increase rapidity of obtaining results, and it is the aim of all registrars of vital statistics to issue their reports at the earliest possible date which is consistent with completeness and accuracy of the information compiled.

The card catalogue system has the advantage of a permanent record, for reference. It has the advantage of sorting by hand, which as has been stated, is preferable in dealing with small totals.

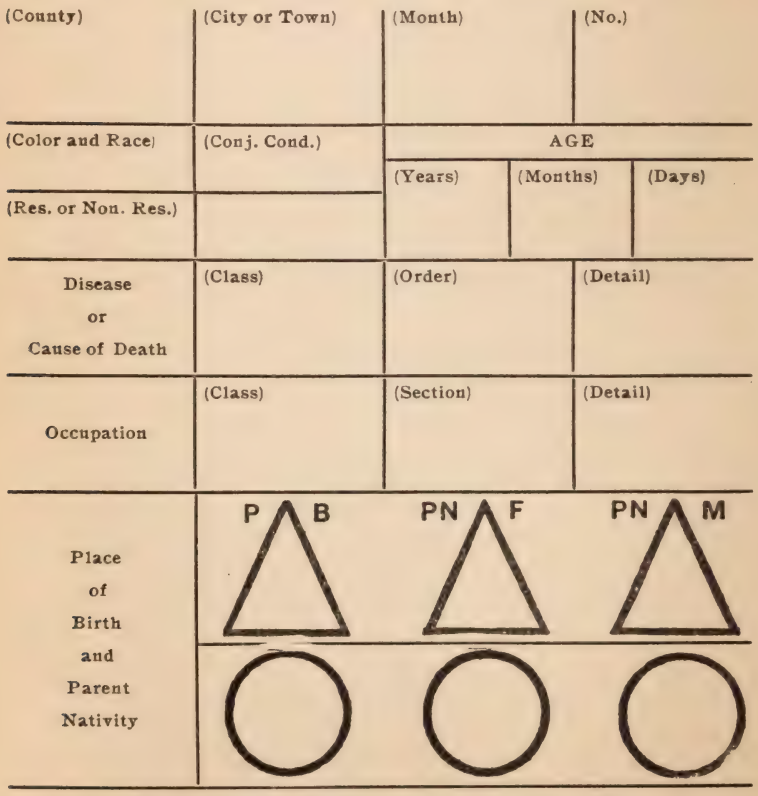
The perforated card system has the advantage of availability of mechanical devices which insure accuracy, but more especially rapidity.

Thousands of cards may be handled in this way when hundreds are counted by hand. One great advantage that this system has, is the possibility of accumulating and sorting to obtain one item, or several, covering a period of five or ten years.

The introduction of the perforated card involves one more process in the operation. The card must be punched by hand, and must be fed to the automatic counting machine.

Reading direct from the schedule, or return, and recording the count automatically by machine, brings the information direct from the return into the total and is thus a saving of time as well as an increase in accuracy. If, however, a mistake is made in recording one too many, or too few of a particular item, it is not possible to correct that except by a re-reading and re-count of that item for all the returns that are in the schedule.

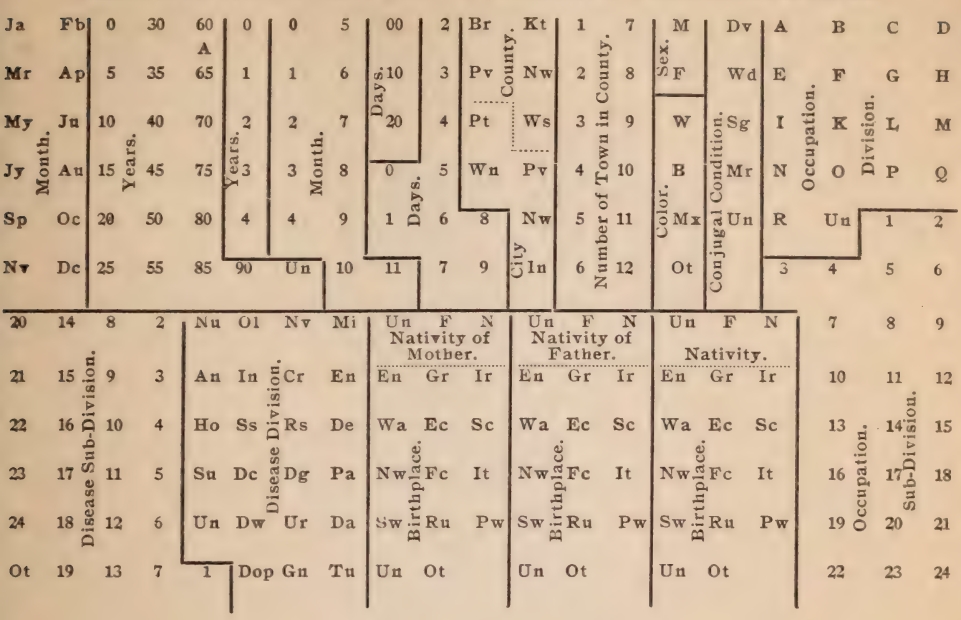
In the use of the dials, with clock hands as indicators, it is very essential that the operator stand directly in front of each dial, for from a



Massachusetts Registration: DEATHS—1887.

Copyrighted, 1887, by CHAS. F. PIDGIN.

DEMONSTRATION OF CARD USED IN HOLLERITH TABULATING SYSTEM.



point diagonal from the dial, the angle at which it is viewed will give a mistaken notation. With the numerical indicator the numbers are at once evident. No counting of intermediate divisions on a dial is necessary, the total being read off at once and noted on the total sheet.

On May 18th last, a commission on the tabulation test for the next United States Census was appointed. This Commission submitted to the contestants schedules representing approximately 20,000 persons which were selected from the population of the returns of the eleventh census. Individual data was to be obtained from these schedules, and to be represented in twelve tables, comprehending a distribution of the population by sex, general natavity, and color, age, conjugal condition, place of birth, parentage, illiteracy, school attendance, citizenship, occupations, and month's employed.

According to the Washington Star of July 28th, "Four systems of tabulation were entered into competition: First, the Hollerith Electric Tabulating System. Second, the Automatic Multiple Counting Machine. Third, the Pin Board Electrical Tabulating System, and the Electrical Typewriter Tabulator," the latter three being entered by Mr. Pidgin, and all of which have been described in this paper.

The Star states that "the Hollerith System completed its work in 185 hours and 53 minutes when considered as the labor of one clerk. Of this total time, 135 hours and 30 minutes were consumed in transcrib-

ing the cards by punching, including 'gang-punching'; 68 hours and 38 minutes in running the punched cards through the electric counting machine, and 11 hours and 45 minutes in transferring the results to the forms of tables as submitted by the Commission. Six hours and 30 minutes of the time was used for the hand sorting of certain of the smaller occupation groups.

The Automatic Tabulating System consumed 452 hours, of which 228 hours were occupied in transcribing (by marking) of the cards. The counting and tabulating occupied 224 hours.

The Pin Board System was not continued through the test but was stopped by agreement, it having been demonstrated that the rapidity of this system was practically the same as that of the typewriter tabulator and the relative efficiency of the two systems could be determined by confining the test to the last named system.

The test of the last three systems was begun on June 14th. Work was continued on the typewriter tabulator until July 27th, when it was discontinued by direction of the Commission. Up to this time 163 hours had been consumed by the test and nine tables were wholly compiled.

The tables relating to foreign percentage and occupation respectively and a part of table seven relating to age detail, had yet to be compiled."

The conclusions as reached by the Commission was as follows: "As the result of the test of the several systems submitted the Commission are jointly and severally of the opinion that the superiority of the Hollerith electric tabulating system for the compilation of individual data which is necessary to be made from the returns of the twelfth census has been clearly and fully demonstrated and they so report."

Of the very few states and cities having any system of registration, Maine, New Hampshire and Vermont use the card catalogue system which consists of a copy of the original return placed upon individual cards by town clerks and forwarded to the state registrar. These cards are then sorted by hand, and the cards filed away as a card catalogue for future reference. As these returns are received monthly, it is possible to keep the compilation well advanced so that at the end of the year a sum total of the months will give total for the year. This system also has the advantage of making it possible to correct any ill defined causes of death, by correspondence with the physician before the end of the year.

New York City makes use of the Hollerith Tabulating Machine, the smaller numbers being counted by hand. The State of Rhode Island made use of the entire Hollerith machine for two or three years, when it was found to be more practicable to sort the punched cards by hand

instead of running them through the electrical counting machine. It is found also that the cards could be punched with greater rapidity, and sorted more readily, than by using the Pidgin card system, which requires markings with pencil.

It is a difficult matter to satisfactorily explain the workings of these various devices without having the machines at hand for demonstration, and should any registrar contemplate the use of any of them, he would naturally visit and examine the devices wherever they might be in operation.

REPRESENTATIVE MORTALITY STATISTICS.

By CRESSY L. WILBUR, Lansing, Mich.

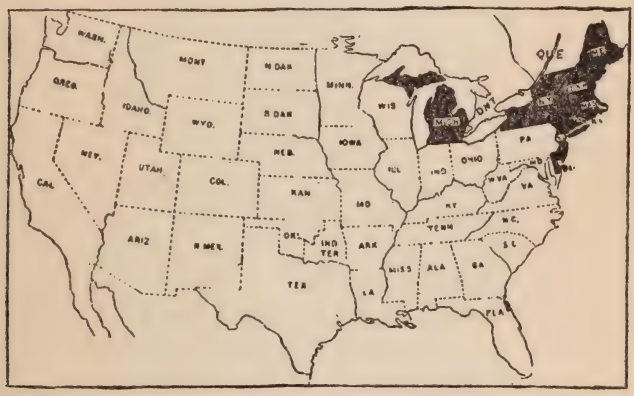
Statistics generally may be divided into two classes, (1) Exhaustive, and (2) Representative. As an example of exhaustive statistics, we may refer to the enumeration of population by the census, every man, woman and child in the entire country being included in the aggregate of population presented. Examples of representative statistics are very common, such as the data representative of meteorological conditions based on observations at certain selected stations, reports of sickness from a limited number of observers, crop reports, special investigations into the condition of certain classes of the population or of special industries, such as are conducted by the United States Department of Labor, etc., etc. Representative statistics are usually employed when on account of limitations of time, expense, and the like, a more complete exhaustive collection of data is out of the question. The method is practically the same as that of the assayer who determines the value of a mineral deposit by the exact analysis of a selected portion of it. If the selection be properly made, the results of the limited analysis of a portion of the material may be fully representative of the constitution of the whole.

The mortality statistics of the census have always been confessedly representative in one important respect, namely, that of time. The enumeration of deaths has always related to the census year only, that is, one year out of ten, and in making any use of the data collected as representative of the mortality of the United States, the assumption has been necessary that this selected year represents fairly average conditions. The assumption is most clearly unsatisfactory, and one of the most urgent pleas in behalf of a permanent census establishment arises from the necessity of a continuous record of mortality.

As is well known, the census statistics of mortality are defective not only with respect to time, but also with regard to the completeness of enumeration during the census year in the so-called "non-registration States." These states comprise a very large portion of the country, as shown by the following map, and the results of the census enumeration of deaths in this area are so imperfect that no reliable information can be derived as to the actual death-rate. For this reason the Association at its last meeting passed a resolution asking that a "Plan be incorporated in the act to provide for the taking of the next United States census whereby reliable representative vital statistics

may be secured for the non-registration States," and your Committee on Demography and Statistics further urged, in a memorial presented to Congress with the cordial endorsement of the practical registration officials representing over half of the total population of the country, that "It was perfectly practicable, within the reasonable limits of expenditure by the census for this purpose, to collect accurate mortality statistics for the non-registration States; or, if the unreliable method of enumeration at the end of the year be retained, as at present provided, then it is also even more feasible to provide for accurate registration in representative areas of the non-registration States, to the end that the amount of deficiency in the returns obtained by enumeration may be approximately known and thus the data be rendered available for important comparisons."

Map showing "registration States" now available for the mortality statistics of the Twelfth U. S. Census (1900).



NOTE.—States having immediate registration of deaths and requiring burial permits are black. The only additions to the list since the Census of 1890 are Maine (1891) and Michigan (1897).

It is unnecessary to insist upon the desirability or practicability of a plan which has received the approval of such a body of practical registration officials, many of them situated in the non-registration States and fully conversant with the difficulties to be met. I shall endeavor in this paper to describe only one of the several ways in which the desired end of reliable representative statistics could be attained, and shall limit myself to the suggestion of a method of accurate registration in selected representative areas of the non-registration states for which a general enumeration of deaths will be made by the census next year as prescribed by the present law.

How shall such representative areas be chosen? They should evidently be large enough so that small accidental variations would not

unduly influence the results. They should contain a fairly typical class of population as regards nativity, age, sex, character of occupations, etc. They should be so situated geographically as to correspond to the general climatic conditions of the area to be represented. Probably a number of counties in each non-registration State could be chosen which would answer these conditions, and in which an accurate registration of deaths for even a single census year would give information of priceless value.

Some degree of tact would be desirable on the part of the Director of the Census in the designation of these districts. The co-operation of the registration services and of the State Boards of Health would be invaluable for this purpose. The imperfect mortality statistics collected by the State governments in many of the non-registration states would correctly show what counties were subject to average conditions of mortality, and the results of the enumerations of deaths by the various preceding U. S. censuses would corroborate these data. The census bureau might readily designate several alternative counties in various portions of the State, any one of which would be satisfactory as regards representative character, and allow the actual selection to be made by the Governor or State Board of Health. This method would avoid any idea of discrimination.

Having selected the representative areas, which for the purpose of this paper may be assumed to be counties, we may now consider the exact method of collecting the data which might be employed. The essentials of a registration system are few, namely, (1) a local registrar, whose district is sufficiently small to allow careful supervision, and (2) a central registration office in close connection with the local offices, and exercising a constant supervisory action over them. The enumeration districts under the census as at present constituted would most excellently answer the purpose of registration districts, and the enumerators should act as registrars of deaths throughout the year for which the data are to be collected. In Michigan, Illinois, Wisconsin, Indiana, Minnesota, Iowa, and other States, the district in rural localities is identical with the township. No provision need be made for cities, since the great defect in registration at present relates to the rural population, and many of the cities even in the non-registration States possess systems of registration under local ordinances.

The local registrars (enumerators) should be appointed early. There would be no difficulty about this, especially if the registration of deaths in non-registration states be taken for the calendar year 1900, as that for the registration states will be taken. The supervisors of the census have already been appointed, and there would be ample time before the close of the present year to select the representative counties

and to appoint the enumerators therein. The force of registrars would thus be in readiness to begin work on January 1, 1900.

The average population of a registration district as thus constituted would probably be under 2,000, and the volume of work arising from the registration of deaths would be small. Suppose the annual rate per 1,000 is 20—a very liberal allowance for the country as a whole—then the number of deaths to be registered by each registrar for the entire year would be only 40, or an average of between three and four each month. This work evidently requires only constant vigilance and accuracy in obtaining complete returns, and does not involve any considerable amount of clerical labor. It will be no hardship upon enumerators to require them to make the returns of deaths for a year at the rate of three or four per month rather than to ask the questions concerning deaths in the preceding year of all persons whom they visit at the time of the enumeration.

How shall the deaths be collected and returned? We may note a sharp distinction at this point between the character of registration service instituted simply for the collection of *statistics* of mortality and a registration service instituted primarily, as are those of all the registration states and cities, for the purpose of preserving a legal record of decedents. In the latter case, regular certificates of death are necessary, giving in legally correct and attested form all of the personal particulars and facts relating to the cause of death required by law, and it has been found, furthermore, that the working of such a system cannot be successfully conducted without the further requirement of burial permits in all cases. Under the varying conditions of local administration, with occasional lax and careless officials and with no regular supervision from a central office, the requirement of certificates of death and burial permits is absolutely indispensable. But it does not follow that it would be practicable, necessary or desirable to enforce such requirements in the representative registration districts contemplated in this plan, and in fact the statistics can be collected with all desired accuracy in a much simpler way.

The registration stations should be rather stations of observation than registration offices in the usual sense. *Every death* should be registered or noted immediately after its occurrence, but the preservation of a perfect legal record would be of less consequence than to have the returns complete and satisfactory for statistical purposes. An attempt should be made to collect only the absolutely essential data, such as age, sex, color (in Southern States), and cause of death. The date of death and locality would appear from the time and place of the registrar's return. It is much more essential for the sanitary officers of this country to know the exact death-rate, the incidence of important

diseases, their seasonal and geographical prevalence, rather than a mass of secondary details relative to birthplaces of parents, etc. There is much information already on file of a sufficiently reliable representative character in regard to the distribution of deaths by civil condition, nativity, etc. These items rarely enter into practical sanitary uses. Thus simplified, there would be little trouble in obtaining complete and accurate registration of all the deaths in each representative registration district.

Reports containing these particulars should be made to the local registrars by physicians, undertakers, clergymen, sextons, baggage agents, and other persons who might be in a position to secure the necessary information. Blank return cards should be liberally distributed about the district, especially among physicians, and undertakers, and the personal knowledge of the registrar would enable him to detect and supply any failures to report. The information cards addressed to the local registrar being carried postfree in the mails would not entail any expense upon the persons reporting.

As an example of a similar system of card reports, in practical operation, the following copies of the face and address side of the card used in Ontario for reporting deaths may be given. (See next page.)

At the end of the month the registrar should enclose all of the card reports received in a penalty envelope and send it to the census office at Washington, with his statement that to the best of his knowledge and belief all deaths that occurred had been registered. The census office would thus be enabled to issue a monthly bulletin of mortality for the entire United States, and the work of registration would begin to bear valuable results for sanitary service within a short time after beginning operation.

The regular mortality schedules should be withheld by the supervisors from the representative districts, and such supervision should be exercised by the supervisors over the work of the registrars throughout the year, or better by special inspectors appointed for this purpose, as might be necessary, in order that the work should proceed regularly and thoroughly throughout the country. Prompt removal from the position of enumerator should follow any neglect of the registration work.

In this simple plan, which is sketched in outline only, it is evident that no additional expense will be incurred, the registrars in the selected districts receiving only the regular compensation of "Not less than two nor more than three cents for each death reported," and that it could be easily extended to cover the entire area of non-registration States without increased cost over the worthless method of enumeration except in two respects, namely, that more deaths would be re-

(Reduced fac-simile.)

FORM C.

ISSUED BY THE REGISTRAR-GENERAL OF ONTARIO.

RETURN OF DEATH.

County .... *Div.* ....

By order of the Postmaster General.

FREE.

Name and Sex		M. F.
Date of Death		
Age	Street or Concession	
Residence		
Occupation		
Where born		
Cause of death and length of illness		
Name of Physician .. .		
Religious Denominat'n		

Date of Return ....

Signature of person making return ....

☞ Neglect on the part of any parent, householder or physician to comply with the Act relating to Births, Marriages and Deaths, is subject to a penalty of $10.00. (Secs. 21-22, 58 Vict., cap. 17.)

.....

Division Registrar.

.... *P. O.,*

ONTARIO,

CANADA.

corded, hence the total allowance for enumeration of deaths would be somewhat increased, and that the cost of the service of general supervision and publication performed by the central office might be somewhat increased. These items, however, would be fully justified by the increased value of the results.

It may be proper here to call attention to the great disproportion which exists in the compensation paid for the collection of deaths under the census and that considered necessary in registration States, as well as to the great difference between the cost of the mortality statistics and the total expense of the census, considered with reference to the final product of Census "reports." The total cost of the Eleventh Census was $11,546,662.50, out of which the enumerators received for returns of 466,396 deaths in non-registration States, at the rate of two cents provided in the law, the sum of $9,327.92. Less than ten thousand dollars for the entire United States, exclusive of registration districts, where the data are collected at State or municipal expense! Yet no less than four large volumes and three special reports out of the total number of twenty-five volumes published by this eleven-million dollar census, were devoted to vital statistics. There were 5,384 pages devoted to vital statistics, or about 20 per cent. of the total pages (26,494) published on all subjects. A beggarly ten thousand dollars was devoted to securing the essential material for this subject from over forty millions of people. At least, with an estimate of 50,000,000 population in non-registration districts for the Twelfth Census, and with a liberally estimated aggregate of 1,000,000 deaths to be thus collected, an allowance of $100,000, or ten cents apiece, for this purpose would not seem extravagant. It is far better to spend money in securing reliable data for statistical study than to waste money and time on imperfect and misleading statistics, as was done so liberally in the last Census.

It is not necessary to go into minute details of the plan proposed. While it is perfectly practicable and would secure reasonably satisfactory results from the start, there would be many administrative difficulties to be encountered, as under any general system of registration, and much adaptability would be required to meet the diverse conditions attending work in different parts of the country. Such difficulties are not insuperable, and it is only necessary to emphatically state at this point that no governmental interference or meddling is contemplated with the local systems of registration. Co-operation in the fullest and broadest sense ought to be employed, not only on the part of the States with the general government, but also on the part of the general government with the states. The central registration office, by precept and example, should aid in the establishment of modern systems of registration by the states, and should assist in the statistical utilization of

the data collected. The government heretofore has presented an example of an almost complete disregard of the interests of the users of vital statistics, chief among whom may be numbered the sanitary workers of the country. While there is no hope of any immediate improvement, or that the vital statistics of the Twelfth Census will be less of a hopelessly disgraceful failure than were those of the Tenth and Eleventh, sanitary workers should realize that this condition of affairs is based largely upon their apathy. Constant, unwearied work in the direction of better statistics, and unremitting, rigorous but just criticism of the faulty methods and principles employed, will, in time, perhaps by the Thirteenth Census, bring about some improvement.

The key to success lies not in the attempt to constitute a national registration system, nor to coerce the non-registration states into undertaking registration for themselves by deprivation of reliable vital statistics, but in the upbuilding of a system of registration which shall be truly national, based on the intimate voluntary co-operation of the State and national governments. In the postal service the government possesses a lever of great potency for this purpose. Mortality returns, when made in such a manner as to be useful for census purposes, ought to be carried postfree, during the census year at least; and States would be anxious to raise their systems to the necessary standard in order to enjoy this privilege. The local registrars might be regularly commissioned, through and with the aid of their State central bureau, as officials of the census, and in this way it might be possible to improve the character of the returns and their general uniformity throughout the registration States. Many other suggestions will occur by which an active, vigorous administration, alive to the demands of the sanitary workers of the country and not pledged in advance to make a *pro forma* enumeration and farce of the mortality statistics of the non-registration States, might raise the mortality statistics of the U. S. Census from their present low condition.

CONTRIBUTION TO THE STUDY OF THE CONTAGIOUSNESS OF PALUDISM AND PROPHYLAXIA OF THE SAME.

By Dr. ADOLFO PATRON MARTINEZ,

of Mérida, Mexico.

Gentlemen—As paludism is, on account of its extent, seriousness and many various forms, constitutes a veritable plague to humanity, often robbing us of our most fertile lands, and being one of the greatest enemies of the growth of civilization, I have not hesitated in occupying myself with this subject, inasmuch as the study of its prophylaxia is, in my opinion, deficient, and this infection has remained separated from the general laws to which other infections are subject, without justifiable reason.

The hematozoon of Laveran being accepted at least by the great majority of bacteriologists and physicians, as the only and exclusive cause of malaria in all its forms, and this opinion being held by all, save in some unimportant details, I shall in this paper explain my views as concisely as possible, and under the following theory:

Malaria is an infectious and specific disease, caused by the introduction into the human organism, of the hematozoon of Laveran, either having its origin among the marshes or transmitted from a diseased organism to a healthy one, whether directly or indirectly. Therefore, the marshes wherein the Laveraneas are developed can contaminate the human organism, just as an unhealthy human organism can contaminate a healthy one, or contaminate marshes where there have hitherto been no Laveraneas.

Extremely arduous is the task that I have selected in presenting this subject, and I trust, gentlemen, that if you devote a little time to the study of so important a matter, you will become convinced like myself, and such distinguished physicians as Coronado, Madan, Delfín, Díaz, Villa, Vera, etc., that malaria is contagious, and that therefore its prophylaxia has up to now been incomplete. The principal scene of my observations has been the State of Yucatan, which forms part of the Mexican confederation, and lies between latitude 18° and 21° 32′ north, and longitude 6° 37′ and 12° 5′ east of Mexico. It occupies the greater part of the Peninsula, and has coasts on the Gulf of Mexico and the Caribbean Sea, all more or less unhealthy on account of the prevalence of paludism, which renders some of those regions completely uninhabitable; but the interior of the State is healthy enough, there

being places where the infection, if not entirely unknown, is at least only sporadic, and I am in a position to assure you that our statistics show that this malady was not as frequent fifty years ago as it is now.

About twelve years ago I was sent by the State Government of Yucatan to the town of Cozumá, which is situated about sixteen miles from the sea, in order to combat an epidemic of yellow fever which had suddenly developed there. In a town of 650 inhabitants, there were about thirty cases daily, with a mortality of about fifteen per cent., which amounted to from three to five deaths daily. The disease resembled yellow fever, the tongue dry and covered with sordes, extreme restlessness, delirium and hemorrhages of the mucous membranes, especially hematemesis or hematuria, there being many cases of epistaxis, sometimes otorragias, etc., the patients would first vomit the food, then the vomitings would be bilious and colloid, rapidly changing to blood and sometimes in such quantities that death would be caused by the hemorrhage itself. Icteric tint, frequently albumin in the urine, anuria, congestion of the spleen and the liver and frequent relapses. This malady was so contagious that there was rarely a house in which there occurred a case, but what the whole family would be attacked by it. Fortunately, among these serious cases were many of various forms of intermittent paludism. Such was the terror caused by this epidemic among the Indians, who, with the exception of five or six families, formed the population of this place, that notwithstanding the aversion which they have to the employment of physicians, they sought the State Government to grant them some relief by sending them a physician immediately.

At first I began by treating the infection as yellow fever, basing my opinion merely on the clinical diagnosis; but as it continued developing and spreading rapidly, and as the mortality also continued on account of the absolute lack of hygienic measures, I began to doubt that it was really yellow fever, as yellow fever never appears spontaneously in those regions; on account of the frequent relapses; because no strangers had lately been there, nor was there any reason to suspect that it was brought in. These facts, taken in connection with the further fact that among its more serious cases I noticed others of the various forms of paludism, whether simple or pernicious; and remembering moreover the many varied forms of the malady, I thought that it might be one of these variations, little known—so I focused the resources of my theraputics on the treatment of the malady, taking as a basis the theory I had so formed.

I then noticed that I had more success, that the mortality diminished, and that the patients treated with quinine salts did not develop those alarming forms, save in an exceptional manner. As my colleague and

companion in this period was by deceased friend, Dr. Abelardo Sauri, I suggested to him that we make an examination of the blood in order to search for the hematozoon of Laveran, finding same in such abundance and in such varied forms, and so clearly that they would not have passed unperceived even by a beginner, as indeed they were not by us. Greatly encouraged by this discovery, I continued the treatment with salts of quinine, and especially with hypodermic injections of chloride, with such vigor and with such complete faith in our treatment that we obtained very satisfactory results. Nevertheless, the epidemic had already extended to the neighboring towns and farms.

On investigating the origin of the epidemic, I learned the following facts: Many of the laborers of the town had gone to the coast to work in the cutting of logwood; and when they returned affected with paludism, one of them was taken ill with vomitings of blood and died. The corpse was kept in the house over twenty-four hours, the rest of the family being affected, the father first and then the rest of the family. A few days after, the neighbors who had assisted at the funeral were also attacked, and thus the malady extended itself from house to house until the whole town was affected. As among those who assisted at the funeral were people living in the neighboring streets, the epidemic began to appear at different points at once with the result that it overran the greater part of the place, and that within a short time.

The town of Homún, distant about three miles from Cozumá, was very soon invaded by the epidemic on account of the frequent communications between the two points; but very soon the inhabitants of the former place determined to isolate the patients, avoid them as much as possible and observe the prescribed rules of disinfection, due to which measures the plague was gradually gotten under control but not before carrying off many victims. The same took place on the neighboring farms.

This malady, without doubt contagious, as it invaded the town like the cholera, was paludism, fully proven by the examination of the blood, and by the axiom of "Natura Moroborum Curationes Ostendunt."

Three years I had occasion to observe the following: The price of hemp being very low, and this article constituting the chief agricultural product of Yucatan, many planters determined to go to the coast and develop the industry of logwood cutting, taking with them a part of their laborers, but leaving the greater portion behind to attend to the cultivation of the hemp. The laborers returned from the cutting of the logwood, afflicted with malaria, and on returning to their homes on the farms which hitherto had not known this infection, propagated it to the extent that within three weeks it had become general,

attacking especially the families of the returned laborers. In the greater part of these cases which came under my treatment, even when the diagnosis was easy and in no way doubtful, I determined to search for the hematozoon, finding same in most cases.

This is another case of paludism, clear in every respect, and in every respect proven beyond doubt to be contagious.

There exists in the State a very serious malady, frequently fatal and very contagious, to the extent that the physicians whenever they perceive it order its immediate isolation, as it is well known to be contagious. I refer to putrid dysentery, an ailment characterized by abundant depositions, which are also numerous and bloody, generally black and fœtid, accompanied by a series of very grave symptoms; sometimes with variable fever up to 41 degrees Centigrade, generally hyperthermia 35 to 36 degrees, cold skin, profuse perspiration, excessive prostration, death occurring thirty-six hours later. Well, this malady, so contagious, so much feared by the physicians themselves, is combatted only by large doses of quinine; and on examining the blood of the patients and that of their depositions, diluted in a small quantity of glycerine and water, numerous hematozoa will be found in different stages of development.

Would you have another proof?

In civil clinics, I have had the two following cases come under my observation, both sufficiently suggestive, and in both cases I made an examination of the blood. A young lady of good family who went to a neighboring farm to spend a short season, found out when too late that there was a good deal of malaria prevailing there, and returned to her home affected by this malady. At the end of a few days the patient developed instead of tertian fever, a temperature of forty degrees and such abundant hematuria as to imperil her life. The blood, which was black and abundant, was full of hematozoa. I at once began treatment by injections of chlorhydro-sulphate of quinine and the fever and hematuria subsided only to be followed by a new access which in turn subsided after the same treatment. A few days subsequently, the servant who attended the patient and came in immediate contact with her blood, was affected by a severe attack of paludism.

Lately, while attending a child suffering from the same disease, I was suddenly called to his bedside, he having suddenly developed violent blood vomitings. I examined the blood under the microscope, finding few hematozoa, probably because the patient had already taken quinine; but the mother who had been splashed by the blood thrown up by the little patient, was attacked by an access of pernicious paludism a few days after.

In my hospital practice I have observed the following: A woman who entered the hospital suffering from a gynecological illness developed a severe access of paludism, probably because while under treatment she came in contact with some other women in the medical department who were then suffering from malaria. As this new illness which she therein developed took a serious aspect, I had her transferred to the medical department for treatment. It so happened that on the following day a new patient occupied the same bed occupied by the patient referred to, and in about eight days after, she too was attacked by paludism.

Finally, I have observed that in the medical department of our hospital, many of the patients who come there for the treatment of various diseases, also suffer from paludism in various degrees and forms.

To the above facts, I have to add the epidemic at Chilpancingo, which occurred in the year 1896. In that city there exists no paludism, as it is situated about four thousand feet above the level of the sea, hence the inhabitants under this belief considered it as a serious attack of yellow fever, until the Professor of the National School of Medicine of Mexico Dr. Demetrio Mejía, on making an analysis of the blood, discovered the epidemic to be paludism. It is supposed that the disease was imported by two persons who went there from the coast, developing into an epidemic by contagion, to such an extent that Dr. Mejía himself was attacked, the existence of hematozoa in his blood having been proven.

I will now add a few cases related to me by my friend, that distinguished physician, Dr. Thomas Vincente Coronado, of Havana, Cuba: A number of small schooners which for a long time had been in the habit of doing coastwise traffic between various points of the island and Havana—points where paludism always prevailed, and which hitherto had not in the least affected the crews of said vessels—having during the late war to transport a number of patients suffering from paludism, and before any change in other conditions, such as food, water, etc., had occurred, now became depositories of the disease, their crews developing very many cases, all of them proven by an examination of the blood.

Two young men suffering from a persistent attack of paludism were sent to be treated at the settlements of San Pedro de la Mota, situated among the hills known as the Cordillera de los Organos, there being no paludism there, that region being about four hundred meters above sea level. The two patients recovered, but they also contaminated various persons with paludism, as was proven by examinations of their blood, and from that time on there have developed veritable epidemics of paludism.

The fact that Dr. Rodriguez, of the town of Bejucal, was attacked by paludism as a result of attending patients suffering from paludism, and at a point where there was no paludism except among patients brought there suffering from diseases contracted in the war, is also suggestive.

In this way, I can submit very many other cases sufficiently clear which prove clinically the contagiousness of paludic infections, cases which have occurred not only in Yucatan and in the island of Cuba, but also in Guatemala and other countries where this disease prevails.

Finally, I will quote the following words of Dr. Herman Eichhorst, taken from his notable work on internal pathology, which show that there are cases outside of the Republic of Mexico, and the Island of Cuba which prove my statement, and that our belief is also shared by some European authors: "There exist, nevertheless, in science, some facts which would seem to prove that the transmission of the disease can be effected in certain circumstances by the medium of persons. Such is the case of Sawyer. Having been attacked, at a healthy place, and where malaria was unknown, by an access of intermittent fever the germs of which he brought with him from a paludic region where he had been before, transmitted the disease by contagion to a lady whom he had attended professionally. I myself have had occasion to attend a servant at a hotel who suffered from intermittent fever, when she had never set foot in a country where malaria prevailed, but who was in the habit of waiting on some Italian workmen connected with the railroad, among whom were a few who then suffered from paludic affections."

"Hjelt is of the opinion that in Finland this disease is developed and propagated more by the social and commercial relations than by residence among the marshy regions at the borders of the lakes and woods."

"Buchner believes that the perspiration of the patient is capable of transmitting the disease to a person who may occupy the same bed."

Therefore, the following forms the basis for my scientific conviction, the following facts having been obtained:

FIRST. In the year 1880 Professor Laveran announced having discovered the specific germ of paludism, describing immediately the hematozoon which bears his name. Since then this fact has become gradually proven, and is to-day proven in the scientific world. It has been proven that the hematozoon only exists in persons attacked by paludism, and it has never been seen in a healthy man, nor in one suffering from a different disease; we must therefore accept that the sole and exclusive cause of this disease is the microzoon described by Professor Laveran,—whether it be one only, in various metamorphoses

or conditions as the great majority of observers hold; or several, as others opine.

SECOND. The intravenous injection of the blood of paludics, into healthy persons, has invariably reproduced the disease, numerous hematozoa having been afterwards discovered among the individuals inoculated. The incubation of the disease lasts from six to eight days, all of this having been proven by the experience of Marchiafava, and Celli, Gualdi and Antolesei, Angelini, Mattei, Colandruccio and others.

THIRD. The injection of the blood of paludics in the subcutaneous cellular tissue produces malaria, as has been experimentally demonstrated by Gerhardt.

FOURTH. The numerous experiments made by Dr. Tomas Vicente Coronado, of Havana, (which I have reproduced exactly) set forth in a pamphlet which was recompensed by the Academy of Medicine of Paris, show that the hematozoa can be cultivated in artificial marshes, the blood of paludics serving as the germ.

FIFTH. This same Dr. Coronado has found in various marshy waters, which were supposed to be sources of malaria, microzoa of the same size and form as those described by Laveran, and for these he has proposed the name of Laveranea Linhemica, which name I have used in this paper. These microzoa have been found even in the waters of the sea. These observations have been proven by various physicians of the Island of Cuba, and especially by those of Matanzas, by Dr. Avila Echavarría in Guatemala, and by myself, studying the marshy waters surrounding the port of Progreso and others in the interior of the Peninsula.

SIXTH. The Laveraneas have been found not only in their natural source, that is to say, in the marshy waters, but also in the blood of men suffering from paludic infection, in the fecal matter and vomitings, as well as in the blood proceeding from hemorrhages of paludics.

SEVENTH. Paludism is transmitted from the mother to the fetus, like smallpox or syphilis.

EIGHTH. Regions where paludism has not before existed can be contaminated and become sources of epidemics merely by the residence there of paludics, as was the case at San Pedro de la Mota, in Cuba and in Chilpancingo, in Mexico.

NINTH. The hematozoa have been found in the air, especially near the marshes where they are produced, in the lower layers of the atmosphere, more especially when it contains a large proportion of water.

TENTH. Paludism has an incubation of from six to eight days, proven clinically and experimentally.

ELEVENTH. The reproduction of the Laveraneas in artificial marshes is prevented or lessened by the addition of solutions of chlorhydrate of quinine in the proportion of two per cent., of bichloride of mercury in the proportion of one per thousand, and of salol in the proportion of five per cent. (This is personal experience.)

TWELFTH. The methods of isolation and of disinfection by heat or by antiseptic substances, such as bichloride of mercury, quicklime, sulphate of copper, sulphate of iron, etc., stop the progress of malarial epidemics.

In fine, the cause of malaria originates from living organisms found in febriferous marshes. These are transmitted to the atmosphere, and from the atmosphere to the human organism either by direct absorption through the respiratory organs, or by being deposited in the drinking water or in the food by means of the air (or by means of mosquitoes which absorb the blood of paludics depositing same on our food, or by direct inoculation) passing through the mucous membrane of the digestive apparatus. This means that a healthy man is exposed to the marshy exhalations and absorbs germs already known, through the ordinary channels, through which there penetrate to our organism other pathogenic germs, which in a period of from six to eight days produce malarial infection in any of its forms. This germ can be again transmitted to the earth and be there reproduced, as will be seen by the experiences above mentioned, contaminating new regions, thus forming new centers for the disease, or contaminating the individual directly, as is shown by clinics and experiments. Therefore, as malaria, like other infections, can be transmitted from man to man by direct contagion, or from the individual to the earth and from the earth back to the individual, by indirect contagion, why should malaria not be classified just like leprosy, tuberculosis, etc., among contagious diseases, if clinics and experimental facts so demonstrate it?

I do not believe that this question is yet settled, except affirmatively, in so far as its contagiousness is concerned.

There is much yet to be done. Is it just as contagious in all its forms? In which of these forms is it most contagious? What is the vehicle or medium of contagion? etc., etc., these are themes for new labors—you count on better and more ample means of experimenting. I can only indicate what my clinical observation has demonstrated: The hemorrhagic forms of paludism are all very contagious; after these come its choleric forms, and then its other forms, in accordance with the following facts: There have always been found in the hemorrhagic liquids a large quantity of hematozoa, a less quantity in the matter thrown up and still less quantity in the fecal matter.

I therefore believe, gentlemen, that paludism being contagious, as I believe I have demonstrated, its public and individual prophylaxia have been until now incomplete.

PUBLIC PROPHYLAXIA. Besides the ordinary means, such as drainage, inundation, etc., there should be added: When a case of paludism occurs, in regions in which the disease has heretofore been unknown, and especially when the cases are hemorrhagic or choleric, the blood and other excremental matters should be disinfected, the hematozoa destroyed by heat or strong solution of an antiseptic nature such as bichlroride of mercury in the proportion of one per thousand, etc. All clothing and bedding should also be rigorously disinfected, as well as any other objects which might supposedly be contaminated. The rooms in which paludic patients have lived, should also be objects of special disinfection, all with the object of preventing the propagation of the disease, as also of preventing the germs from being reproduced in the earth if the local conditions are appropriate, thus forming a new focus for said germs. The patient should be rigorously isolated.

INDIVIDUAL PROPHYLAXIA. Besides the preventives generally recommended, of not drinking unboiled water, not exposing one's self to marshy emanations, rigorous hygiene, etc., there should be added, the necessity of avoiding remaining in the quarters occupied by patients suffering from paludic infection, that is, whenever indispensable; avoiding the eating of anything in the rooms occupied by the patient, the frequent washing of the hands and of the clothes whenever it is supposed that they have been touched or soiled by the blood, perspiration, fecal or other matter emitted by the patient, following minutely all the care recommended to those coming in contact with patients suffering from any contagious disease.

REPORT OF THE COMMITTEE ON ANIMAL DISEASES AND ANIMAL FOOD.

By D. E. SALMON, D. V. M.,

Chief Bureau of Animal Industry, Washington, D. C., Chairman.

Mr. President—Your committee to which has been referred the important subject of animal diseases and animal food would respectfully report that there have been no unusual outbreaks of epizootic diseases during the year. The infectious diseases of swine have continued to about the same degree as heretofore, destroying perhaps fifty millions of dollars worth of these animals and diminishing the available food supply to that extent, but otherwise have had no appreciable effect upon the public health. There has been considerable anthrax among the animals of the southern part of the Mississippi Valley, particularly in the State of Louisiana, and it is reported that the contagion has been carried to Texas, causing more or less alarm in the regions affected. It should, also, be mentioned in this connection that there have been some cases of anthrax among animals and men in other parts of the country, caused by contagion imported with foreign hides. There appears to be no satisfactory way of guarding against the introduction of the anthrax contagion through this channel. The great resistance of the spores of the *bacillus anthracis* to disinfectants, the existence of these spores below the surface of the hides, and the difficulty or impossibility of complete disinfection by present methods without injury to the hides leads to evasion of the requirements for disinfection, or to very superficial compliance. For these reasons this contagion is a most difficult one to exclude, especially as it is brought in hair and wool as well as in hides.

The question of tuberculosis is still being debated in many parts of the country, and it is to be regretted that some dairymen and their friends are using their influence for the preservation of the disease rather than for its eradication. This is a short-sighted and dangerous policy, not only for the public but for the dairymen as well. There is nothing to be gained by advocating a policy of protection for tuberculosis. While the dairymen who are so unfortunate as to have the disease in their herds should not be treated with harshness and their business ruined by undue haste and publicity, it appears plain to your committee that the complete eradication of the disease from every affected dairy should be the policy of all sanitarians.

There have been some doubts expressed by a few gentlemen who have reputation as scientific men, in regard to the danger to the human subject from the products of tuberculous cows. Leaving the flesh out of consideration as being the least dangerous of these products, it may be said that unquestionably the *bacillus tuberculosis* is common in the milk of tuberculous cows, both when the udder is diseased and when it is not; that the feeding of such contaminated milk produces tuberculosis in swine and calves as well as in smaller experimental animals; that there are numerous cases of tuberculosis in mankind, especially in children, in which the initial lesion clearly indicates the entrance of the contagion by way of the digestive canal; and, finally, that there are a certain number of cases recorded clearly proving the inoculability of bovine tuberculosis upon the human subject.

With this chain of evidence, the sanitarian cannot hesitate as to his duty with a disease so common and so deadly in its character. Would we not have reason for surprise that anyone should advocate the sale of milk from cows affected with any serious disease whether or not such disease is communicable to mankind? And how much more reason for surprise is there that anyone should advocate directly or indirectly the sale of milk from cows affected with the most fatal disease which attacks the human race. It is not sufficient in this case to minimize the danger by asserting that some of the bacilli found in milk and heretofore accepted as tubercle bacilli are really harmless saprophytic germs, or that the proportion of abdominal tuberculosis in children is less than was formerly supposed by some writers, when it has been established that there is a form of tuberculosis which is caused by infection through the digestive tract, that bovine tuberculosis is communicable to man, and that the milk of tuberculous cows in a large proportion of cases contains the true tubercle bacillus. Such arguments as have been mentioned may mislead the laity but they should not deceive the sanitarian.

The statement has also been frequently made that the number of cases of tuberculosis in the human subject in which the initial lesion indicates that the contagion was conveyed through the food are so small relatively to the total number of cases that this variety of infection is scarcely worthy of attention. This argument appears somewhat farfetched and illusory. We may reasonably ask, how many cases of tuberculosis from animal infection are necessary to keep up the disease in the human subject? It might just as reasonably be argued in the case of smallpox epidemics that the number of cases caused directly by imported contagion is small compared with the number of cases which is produced by contagion between our own citizens, and, yet, every health officer knows that to stop the importation of contagion is essen-

tial to the success of his repressive measures. May we not, therefore, compare the few cases of tuberculosis in man which result from animal food, with the few cases of smallpox, yellow fever or cholera, which, entering our ports, are sufficient to cause most extensive epidemics? It appears to your committee that this aspect of the question should not be entirely neglected.

In some of our states, particularly in Pennsylvania, intelligent and successful work for the repression of tuberculosis in cattle has been in progress for a considerable time without injury to the dairymen and without exciting their opposition. This indicates that it is possible by a conservative and considerate policy, to harmonize all interests and at the same time to conduct effective work. There is no doubt but that the successful handling of tuberculosis is one of the most difficult problems of the time, but your committee believes that the difficulties are not insuperable, and that by studying the methods of those who are doing the best work with a minimum of friction it will be practicable to outline a general policy of procedure which will be both effective and satisfactory to the people most directly interested.

It is fortunate that the great beef producing stock of cattle is but slightly affected with tuberculosis. In the inspection service of the Bureau of Animal Industry from July 1 to December 31, 1898, there were inspected in the abattoirs 2,309,000 head of cattle from which 1,510 were reported affected with tuberculosis. This is about one in fifteen hundred, a proportion so small as to indicate that the danger from that source need give no present concern. In Europe from 20 to 50 per cent. of the cattle killed at the abattoirs are tuberculous, which gives a most extraordinary contrast to the condition existing in the United States. As the bacilli are seldom found in the parts of the carcass generally used for food, and as the flesh is cooked before it is eaten, the consensus of opinion is that the danger from meat even under the worst conditions is not to be compared with that from infected milk.

Your committee desires, also, to invite attention to the subject of rabies and to the success which has been obtained in Great Britain by requiring the muzzling of dogs in the infected districts. The number of cases reported in that country was 160 in 1888, and 312 in 1889. Late in the latter year it was found that the enforcing of the muzzling order in London had given such beneficial results that it was extended to other parts of the country. The result was a steady decrease in the number of cases, there being but 129 in 1890, 79 in 1891 and 38 in 1892.

In 1892, owing to vigorous opposition, the muzzling orders were withdrawn by the Board of Agriculture and the matter left in the hands of the local authorities. From that time the number of cases steadily

increased, there being 93 in 1893, 248 in 1894, and 672 in 1895. The last was one of the worst years in modern times with reference to this disease. As a result of this condition strong pressure was again brought to bear for vigorous and effective measures for controlling the disease. The local authorities enforced their regulations more rigidly in 1896, and in 1897 the Board of Agriculture again assumed authority with a view of eradicating the disease from England and Scotland. As a consequence of these measures the number of cases was reduced to 438 in 1896, 151 in 1897 and 17 in 1898.

This remarkable success shows what can be accomplished with this disease through proper sanitary regulations. In the United States we have no statistics of rabies but the existence of the disease is well known, and numerous cases have been reported by persons competent to make a reliable diagnosis. Your committee is of the opinion, therefore, that health authorities should be sustained in their efforts to reduce the number of worthless and ownerless dogs and in requiring the muzzling of dogs in districts in which the disease appears.

REPORT OF THE COMMITTEE ON CAR SANITATION.

By Prof. S. H. WOODBRIDGE, Boston, Chairman.

Part I.

Your Committee on Car Sanitation in the report rendered to the Association at its last meeting made the suggestion and recommendation that the Association put itself into active touch with the State, Provincial, and other local Boards of Health, and also with railroad managements for the purpose of inspiring and assisting the former to efforts directed to the protection of the health of the traveling public, and to learn from the latter their attitude toward such matters, as evidenced in the means already emolpyed, and in their willingness or desire to avail themselves of the best hygienic service which the public welfare may reasonably demand. The importance of sympathetic cooperation has seemed to the Committee so evident that a circular letter has been addressed to the several Boards of Health of the different states and provinces, a copy of which is herewith given.

Boston, August 9, 1899.

Dear Sir—It is the desire of the American Public Health Association, through its Committee on Car Sanitation, to serve to the best of its ability the hygienic interests of the traveling public, and, to that end, to secure on the part of the Several State, Provincial and other Boards of Health such interested and concerted effort in behalf of those interests as shall tend to a continuous advancement along the lines of car sanitation.

With the increasing multitudes affected by faulty sanitary conditions within railway coaches, the improvement of the hygienic conditions existing in such vehicles becomes more imperative. The indiscriminate herding of all kinds and conditions of humanity within the narrow and tight-walled limits of steam and street railway cars, the not infrequent presence in such cars of passengers infected with communicable disease, the carriage of that disease in microbic form in the confined air, its presence in dust which the jarring motion of the car and the movement of occupants and the air within the car tend to keep afloat, and also the depressing effects of vitiated, impoverished and often over-heated air which enervates the most robust and exposes all to greater susceptibility to infection, are matters of common knowledge among students of public hygiene.

It is unhesitatingly believed that the great aggregate of human energy lost and human health sacrificed through such causes is worth making an earnest effort to conserve, and that the aggregate of resulting disease is serious enough to warrant professional and govern-

mental insistence on preventive measures, and that prevailing conditions justify a public demand that such protection as may be afforded in a generous use of air for the dilution and removal of atmospheric impurities, and of brooms, beaters, water, soap, antiseptics, sterilizers and disinfectants for the removal and destruction of morbific matter in dust or other form, shall be effectively employed.

For the guarding and furtherance of its hygienic welfare the public has organized Boards of Health for the very purpose of promoting public health, and the range of their legitimate effort is co-ordinate with the public hygienic need. It is to them that the public looks as the proper medium through which its organized protective and aggressive work is to be done.

The American Public Health Association as a volunteer organization, has taken up the study of car sanitation for the purpose of gathering information and material and of stimulating inquiry and effort with reference to it, and also of eliciting intelligent public interest in a matter which it believes to be of no small importance to the common welfare. This Association desires to co-operate with governmental boards, and, so far as it may be advantageous to do so, to serve as a medium of inter-communication between such boards, and to render such service as opportunity may offer in the effort to better the sanitary environment of the traveling public.

There have been sent to your board papers on car sanitation prepared by the undersigned for the American Public Health Association. The purpose which inspired the preparation of these papers and the forms given to them are made sufficiently evident on their pages. It is hoped that the discussion they were designed to provoke may be forthcoming, and that through such discussion much of value in the way of information, suggestion and impetus may be gained.

The American Public Health Association would be much gratified to obtain from you a communication on the subject of car sanitation in any of its phases which may have occupied the attention of your Board, and to receive suggestions as to the most practicable and promising line of action for furthering the ends of hygiene in connection with public conveyances.

The subject of car sanitation includes the antipollution regulations with reference to expectoration recently enforced in many localities; the disinfecting, the airing and the warming of cars, whether steam railway or tramway; the nature of, and the care and treatment given upholstery and bedding; the rules and practices of companies with reference to the cleanliness of the coaches they furnish for the public use; the precautions adopted in providing pure water and ices for drinking purposes; and in the cleansing and sterilizing of towels, and toilet articles; and also, of health requirements of State laws regarding such matters and the practices which actually prevail in various localities.

Information touching these or other related particulars is greatly desired, and any suggestions you may be pleased to offer with reference to lines of procedure on the part of State Boards of Health and of this Association most likely to result in the development of this

branch of public hygiene, will be appreciated by the Association, and especially by its Committee on Car Sanitation.

It is desired that information of the nature asked for should be sent in by or before the middle of September next, in order that the material may be used in working up the report to be submitted to the Association at its next meeting, to be held during the first week of November. Respectfully yours,

S. H. WOODRIDGE,
Chairman.

Replies have been received from the following Boards: States—Colorado, Iowa, Maryland, Massachusetts, Michigan, New York, North Carolina, North Dakota, Pennsylvania, Rhode Island, Texas, Ohio, Indiana. Provinces—Ontario, Quebec, Winnepeg.

The facts stated and suggestions offered in some of the communications received are summarized as follows:

One Board suggests the preparation of a special paper on the subject of car sanitation to be presented to the Association for the purpose of securing definite action along the proposed lines. Another states that the sanitary condition of the cars in use in its territory is sometimes good, at other times bad, but most of the time vile. This Board has never taken the matter of car sanitation into consideration with a view of bettering the condition of affairs, but intends to avail itself of the first opportunity for doing so which offers. The Board considers the importance of the subject undeniable.

Another Board reports, "We have done almost nothing in this line. We are anxious, however, to act intelligently, and will be glad to receive such suggestions as your Committee may be able to give us."

The Secretary of one Board reports, "I am very desirous of placing the subject before the Legislature in the most impressive and practical form." Another communication contains the following: "Nothing has been done so far in this state on the line of car sanitation. It is a very important matter and I hope other states will set us a good example, and point the way that we may follow."

The response from North Dakota contains the following: "I am deeply interested in the subject of car sanitation, and as the State Legislature has generously given the State Board of Health full powers to pass such rules and regulations as will tend to conserve the public health, I at this time see no difficulty in the way of enacting such laws as the American Public Health Association may see fit to suggest and authorize. A very pernicious practice in vogue in this state I may for the moment call your attention to. It is the repeated sweeping of

the cars by brakemen while occupied by passengers. If this one practice can practically be interdicted I am sure it would be of untold benefit, and I am much inclined to notify all railroads operating in the state of the necessity of a change in this direction, but believe that any suggestions made to the railroads should have the Association's endorsement."

Another State Board's answer contains the following: "Anti-expectoration laws have not yet been enacted, but the Board anticipates an application to the Legislature for such legislation as may be necessary."

The response of the Ohio State Board through its Secretary is substantially as follows: "Our State Board of Health has not done much in the way of railway sanitation. We have sent circulars and instructions to the various railroad companies operating in this state in reference to some of the practical phases of railway hygiene, and as a rule they have been well received. The subject is such a large one and the many difficulties in the way of carrying out needed reforms are so great that we have been rather discouraged about taking hold of the matter in any active way. It seems to me that if your committee could formulate certain minimum requirements which might be enforced by every state and provincial board of health, that a most excellent work could be begun. The question of ventilation of railway cars is of importance, and the railroads themselves seem anxious to do something in this way if they can be told in a practical way how to do it. The proper disinfection of railway coaches is also doubtless of much importance but we must still wait for practical methods to be introduced.

"In the meantime there are a number of minor matters which it seems ought to be controlled and certainly could be controlled if the railroad companies could be properly instructed in the matter.

"Take the question of temperature, which is usually controllable. Many of the railroad cars I travel on are still without thermometers, or if they have them they are totally disregarded by the trainmen. Cars are not kept clean and especially the water closets on cars. On through trains it is still the practice, at certain stations, for men to come into cars and while they are occupied by passengers attempt, in a rough way, to clean them by sweeping and dusting, filling the atmosphere with dust which must often be infected.

"I doubt if any attention is given to the water tanks on trains, and some that I have looked into seemed to be filthy. Probably nothing is done in the way of insuring that the water put into these tanks is pure. The manner of icing trains is disgustingly dirty and fraught with some danger. The train stops, a man with grimy hands comes

in with a bucket of broken ice and with these same hands crowds this ice down into a water cooler.

"The wash bowls on most of the Pullmans are so constructed as to make it almost impossible to properly clean them. You get up in the morning, on a sleeper, and find someone, possibly with tuberculosis or some other contagious disease, cleaning his teeth and hawking and spitting into the wash bowl. Many of these bowls are arranged with a plunger to stop the outflow of the water and this construction is peculiarly adapted to harbor all kinds of filth.

"These are only a few of a number of the minor discomforts, if not dangers, that one encounters in railway traveling, and which railroad companies could easily remove. It ought to be made a part of the schooling of every conductor and brakeman to look after the sanitary condition of the cars of which they have charge, and if the railroad companies would ask the traveling public to report to them all negligences of the kind I have mentioned, they would soon teach their employes the necessity of looking after such details.

"I should be very glad if your committee could present to the Association a set of rules and regulation relating to car sanitation which could be enforced in any state. I feel sure our Board of Health would be glad to adopt such regulations and think we would be in a position, if other boards could adopt them, to have them enforced in this state."

From the State of Indiana the following response has been received: "The State Board of Health of Indiana, during the past year, has continued its efforts for better car sanitation. It is our contention that sanitary construction will be absolutely necessary to secure proper sanitation. Under the present construction, unusual and extra diligence is required in cleaning and disinfecting. Cleaning enroute has been urged and re-urged. From many of the railroad companies operating in Indiana, promises have been to the effect that future equipment will be constructed as nearly in accord with the ideal sanitary principles as possible, and in the meantime repairs to all old equipment will be made with sanitary ideas in view.

Several companies in Indiana are now regularly disinfecting coaches at cleaning terminals. The "Big 4" and the Wabash lead in this, rigidly requiring disinfection by a special order. Two new parlor cars recently added to the equipment of the "Big 4" are constructed, so far as sanitary conditions are concerned, in accordance with the sanitary principles heretofore presented by the Indiana Board. Angles, edges, panels, bead and channel work, and carvings which may catch and entangle dust and dirt are not present. The upholstering of chairs is removable for dusting with air blast and sterilizing. Dra-

peries are reduced to a minimum and are easily removable. Carpets are in duplicate, so more time may be given for cleaning at terminals. Clean linen covers for backs and arms of chairs are provided *fresh for each occupant.* Special effort has been made to induce railway companies to post anti-spitting notices in cars and stations. The form adopted is as follows:

SPUTUM (SPIT) IS DANGEROUS.

INDIANA STATE BOARD OF HEALTH REGULATIONS TO PREVENT COMMITTING A NUISANCE BY SPITTING UPON SIDEWALKS AND OTHER PUBLIC PLACES.

SECTION 1. Spitting upon sidewalks, floors of public buildings, halls, railway stations, stairways and public conveyances being frequently the means of communicating disease, is therefore a *nuisance* and is hereby forbidden.

SECTION 2. Any person violating the above regulation shall be punished for committing a *nuisance* as provided by the statutes.

Passed January 6, 1899.

"The 'Big 4' will soon have this notice in all passenger coaches and in all stations. In smoking cars, paper cuspidors will be issued to spitters, and small cards presenting reasons against spitting will be distributed. It is the Board's opinion that much better conditions will soon result from this. Incoming statistics indicate that typhoid fever has increased in Indiana this fall, and this we think may be justly attributed in some degree to our returning soldiers having distributed the disease over the state from railway cars. The possibility of this being the cause will be recognized, and this suggests that the present railway coach closet is a nuisance to be suppressed. It seems practicable to catch excreta in a receptable beneath the hopper, cover with dry earth, and empty at terminals, care, of course, being taken to make proper disposal."

To an apparent misunderstanding of mention made in the circular letter regarding papers sent with it, or else to the failure of some of the missives to reach their intended destination is probably due the failure of some Boards to respond to the letter addressed them. The small supply of papers was exhausted with the first issue, and subsequent requests for duplicates could not be met. The responses depending upon the receipt of such duplicates have not, therefore, been received. It is believed that a more general reply would have only more strongly emphasized the consensus of opinion found in the letters received by your Committee.

The correspondence has developed the facts: First, that the Boards of Health regard the present status of car sanitation as so seriously defective as to warrant action by State and other Boards of Health.

Second, that they consider it appropriate that the American Public Health Association should take the initiative in such action by formulating for the use of railway managements recommendations with reference to the hygienic care of railway coaches and stations, and by embodying its convictions in recommendations prepared for the guidance of health boards in their efforts to aid railroad managements, and to secure needed legislation for the protection of travelers from avoidable dangers to the health; and, third, that for the most part, the railroad authorities are found ready to co-operate with health boards, provided the demands of such boards are reasonable, and have the common consent and approval of the confederated and co-operating health boards.

Unless the evidence thus far secured is misinterpreted the time seems opportune for an aggressive movement on the part of the Association, and it is suggested at its present meeting a committee be appointed to consider the advisability of draughting regulations in regard to car sanitations to be offered to railroad managements throughout the continent, and also suggestions regarding the service health boards may render through co-operation with railroad managements, and also by securing the enactment of such abetting laws as the conditions of each locality may require or make possible. If such moves are made during the interim between the present and the next meeting of the Association, provision should be made for the printing and distribution of papers, and also to meet the expenses of correspondence.

REPORT OF THE COMMITTEE ON CAR SANITATION THROUGH ITS CHAIRMAN.

Part II.

For the dual purpose of obtaining information for the guidance of the Association, and for learning of the importance attached by railway managements to car sanitation, and also their methods of protecting their patrons from the dangers of unsanitary conditions, the following letter was sent to the managers of seventy railroads of the continent. Accompanying this letter was a second to be forwarded by the superintendent or manager to the proper official for filling out the blanks:

Boston, September 16, 1899.

(Addressed to railroad managements.)

Dear Sir—Please find enclosed a copy of the last report of the American Public Health Association Committee on Car Sanitation.

The Association is organized for the purpose of discovering and reducing preventable disease. The aggregate of human energy suffers unnecessary encroachment and enormous loss through causes which are largely within human control. To the knowledge of this fact civi-

lized communities have partly awakened, and also to the culpability of neglecting preventable causes of diseases which impair health, or prematurely terminate life.

Of the preventable causes of disease the larger part are those whose origin is in microbic or low forms of organic life which find in the body rich pabulum and stimulating conditions favorable to rapid growth, enormous development in numbers, and to virulent activity.

Disease germs enter the body through contact with infected persons, or with clothing, bedding, toilet linen and articles, or other material exposed to the person, or to the cutaneous, pelvic, or thoracic eliminations from such persons; also through the breathing, or even, in some cases, the contact of air contaminated by such means; and by the drinking of water, milk, or other liquids, and by the eating of foods containing morbific germ life.

Car sanitation aims at the removal of such menace to health and life, in some instances by the isolation of passengers known to be suffering from infectious diseases, and always by effective methods for protecting travelers from every danger attending either the present or past presence of those affected with any form of communicable disease, and by the serving of drinks or foods made free from the germs of such disease by the exercise of intelligent care.

General sanitation directs its chief efforts to cleanliness. Car sanitation is concerned in the thorough cleanliness of the car itself, its floors, walls, upholstery, draperies, carpets, sanitary fixtures and toilet furnishings; the purity of the air and of the water and food served. Such cleanliness as is required cannot be had by the removal and avoidance of visible dirt alone, however important that may be. The only dangerous dirt is in its nature unseeable, being microscopic. It floats in the air, lodges on, and is contained in fabrics, adheres to surfaces, hides in minute and larger recesses, lurks in drinking fountains, and is preserved in the cold-storage of pond and river ice. The sweeping and the soap and water mopping of floors, the removal and outdoor beating of upholstery, the airing and beating of bedding, the boiling of bed and toilet linen in the laundry, the washing of fixtures, and the ordinary cleaning of toilet furnishings are the usual means employed for cleanliness. They are good so far as they go, and are, indeed, indispensable. They are not sufficient, however, to remove the danger residing in microbic and vital microscopic dust. That must be removed, first, by the ordinary means employed for cleansing; and, second, by keeping the air—nature's principal vehicle for the carriage of microbes—as free as possible from them; and, lastly, by the devitilizing—by the use of effective germicides—of such dust and dirt as cannot be removed by the ordinary processes of cleaning.

Among the diseases now well recognized as communicable by vital dust is tuberculosis. A single expectoration from a person afflicted with pulmonary tuberculosis may contain a million tuberculosis germs. If such sputum is ejected on the floor and dried, the germs as loosened will be free to float in the air. If such dried sputum is brushed with a broom, it is partly loosened and sent into the air as dust. Some finds its way into the dust-pan, and some remains, either adhering to or lying loose upon the floor, or settling down upon the car surfaces. If

the floor be mopped the infectious matter is partly removed and partly spread over the floor in a form and in a place that makes its final reduction to dust more certain.

The danger cited is but one among many. The presence of a person affected with any form of communicable disease, or the infectious eliminations of whatever sort left by such persons on the floor or other surfaces, upholstery, draperies, toilet furnishings, in the air, or in any manner to expose others to inoculation, is a source of danger which, if not preventable, is yet greatly reducible. The fact that pulmonary consumption is a communicable disease, and that many more thousands are yearly carried off by it than by any other one form of disease, makes both the danger and the importance of preventive means in connection with that scourge evident. Other less prevalent but more virulent diseases call for equally vigilant protective measures.

Isolation of infected cases in public conveyances may not be practicable except in recognized cases of such sickness. Failing in this, special, frequent and readily employed means for cleansing should be employed. If the floors must be swept, it should be done with the car windows wide open and with the air freely moving through the cars to ensure as far as possible the removal from the car of the dust raised in the process. Floor surfaces and sanitary fixtures should be treated with water containing effective germicides. Carpets, draperies, the upholstery of the seats, the pillows, mattresses, blankets and beds should be thoroughly aired and beaten, and periodically subjected to some effective sterilizing and antiseptic treatment; the linen of the beds, toilet rooms, buffet and dining room cars should be sterilized in the laundry by boiling water. All such work should be done by employes in good health.

Finally, because the atmospheric conditions within enclosures produce marked effects on the vitality of those subjected to them, and because even a temporary lowered vitality exposes the subject to greater danger of harm from disease germs, therefore the atmosphere within cars should be kept such as to invigorate rather than enervate the passengers. Free ventilation is effective in two ways. For any given number of bacteria or bacilli floating per hour into the air of the car, the greater the air quantity passing through the car, the less the number of such germs in the air of the car at any one time. Doubling the pure air quantity furnished by ventilation reduces the number of the floating microbes to one-half, and correspondingly reduces the danger from exposure, while at the same time the improved air quality invigorates the occupant, thus enabling the system to more successfully resist microbic attacks.

The facts now called to your attention are of greater moment than the brief mention of them would seem to indicate. They are deemed by the American Public Health Association to be of sufficient importance to warrant the appointment of a committee to confer and cooperate with State, Provincial and other local Boards of Health, and also with railroad managements for the purpose of securing better protection of public health than now exists against dangers encountered in travel.

For the purpose of obtaining information from the leading railroad managements within the territory covered by the Association, and of more intelligently aiding such managements in their efforts to protect and promote the public health, it is the desire of the Association to learn of the methods to these ends now employed by the several railroad companies. To facilitate the work of obtaining such information as is desired, and of securing it in such form as shall be most serviceable for the purposes of the committee, the enclosed blanks are forwarded to you with the hope that your cordial co-operation may be given to the efforts of the Association. If so, be good enough to put enclosed paper into the hands of the official of your road most competent to aid the work of the Association.

The annual meeting of the Association occurs in October, and it is the desire of the committee to then present facts relating to the practice of the railroad managements in such matters, and to formulate plans for most practically and substantially aiding the efforts of such managements. It is therefore hoped that your response to these inquiries will be received in season to be of service at the coming meeting of the Association. Very sincerely, for the Committee,

S. H. WOODBRIDGE,
Chairman.

To be given the official who may be directed to answer the questions:

It is the desire of the American Public Health Association to cooperate with the public through its authorized functionaries and the medical profession, and through those whose enterprises and their management closely affect public health. Among the latter are corporations engaged in the business of the railway transportation of passengers. Into passenger cars—day, parlor and sleeping coaches—are admitted all manner of people in all conditions of healthfulness and cleanliness. The herding together in this manner of all conditions of humanity exposes the well to the diseases of the sick.

The modern, and, as it is believed, the correct, explanation of the spread of much of the disease which afflicts the human race is found in the germ nature of the more serious forms of disease. These germs pass from the diseased to the well through personal contact, through air which carries the germ in dust form, and through water or food contaminated by such germs and taken into the system. The importance of protecting the well from these germs is being more and more emphasized, and all reasonable and feasible measures directed to this end are coming to be increasingly insisted upon as demanded by humane considerations, and which sooner or later will be made compulsory under the force of law.

In order that the Association may further this important branch of public hygiene, it desires to ally itself with all who are making or are willing to make earnest effort in that direction. In aid of this purpose

and effort on the part of the Association, it is desired that information with reference to the practices which prevail in the several railroad managements in relation to the following matters, should be obtained.

First, in regard to the isolation of passengers known to be suffering from communicable diseases. Second, the prevention, as far as practicable of the communication of contagious disease through any of the several methods by which the bacteria or bacilli of such disease may pass from one passenger to another. These matters are covered by the following queries, your replies to which will be sincerely appreciated:

Up to date of writing some forty responses have been received, thirty of them enclosing the paper with questions answered. Others have written of their interest in the subject, and of their willingness to forward all possible information when time of busy officials could be spared for attending to the matter. Full replies have been sent in by the following roads:

1. Atchison, Topeka & Santa Fe.
2. Atlanta & West Point R. R. and Western Ry. of Alabama.
3. Atlantic Coast Line.
4. Colorado R. R.
5. Burlington & Missouri River R. R. in Nebraska.
6. Central Vermont R. R.
7. Central New England R. R.
8. Chesapeake & Ohio R. R.
9. Cincinnati, New Orleans & Texas Pacific R. R.
10. Chicago, Rock Island and Pacific R. R.
11. Columbus, Sandusky & Hocking R. R.
12. Delaware, Lackawanna & Western R. R.
13. Denver & Rio Grande R. R.
14. Fitchburg R. R.
15. Grand Rapids and Indiana R. R.
16. Grand Trunk R. R.
17. Great Northern R. R.
18. Lehigh Valley R. R.
19. Long Island R. R.
20. Louisville & Nashville R. R.
21. Michigan Central R. R.
22. Missouri, Kansas & Texas R. R.
23. Norfolk & Western R. R.
24. Northern Pacific R. R.
25. Pennsylvania R. R.
26. Plant System.

27. Southern R. R.
28. Terre Haute & Indianapolis R. R.
29. Terre Haute & Indianapolis Northwestern R. R. Co.
30. Union Pacific R. R.

The answers given to the several questions have been grouped as nearly as the variety of methods of answering has made practicable. The answers so grouped appear in the following tabulated form of questions and replies:

1. *Avoidance of dirt and dust accumulation.*

Q. 1-A. Are hard and non-absorbent materials susceptable of polish, and polished, used in the interior construction of your passenger cars?

An. "Yes." From one to thirty inclusive.

Q. 1-B. Are the forms given to surface such as to avoid recesses, grooves, pockets, and ledges for the deposit and retention of dust and dirt?

Ans. "Nearly all cars have ledges and pockets for retaining dust." 2, 3, 9, 11, 12, 14, 15, 18, 19, 20, 22, 23, 29. (13)

"In all new cars, and when changes are made in old cars." 4, 7, 24, 30, 31. (5)

"Not to the extent we should." 5. (1)

"As much as possible consistent with strength of construction." 6, 8, 27. (3)

"Generally, but so far no special effort to accomplish this result." 13. (1)

"Yes, as much as possible correspondent with style of cars." 16. (1)

"In new equipment." 17, 21, 26. (3)

"With the exception of carved and reeded surfaces there are no places likely to retain dust and dirt." 25, 28. (2)

Q. 1-C. Are the seats made with removable backs and bottoms, and is the upholstery material chosen with reference to a minimum retention of dust, and made without button pockets, etc.?

Ans. "Plush upholstering, seat bottoms made removable, no buttons used in upholstering." 1, 2, 3, 8, 11, 22, 23, 30. (8)

"Seat bottoms and backs removable." 4, 5, 6, 7, 9, 10, 12, 13, 14, 15, 16, 17, 18, 25, 26, 28, 29. (27)

"Seat bottoms and backs removable in all new cars." 20, 21, 27. (3)

"Plush and rattan seats." 19. (1)

"Sleeping cars have buttons and pockets." 24. (1)

Q. 1-D. Are seats when finished in plush upholstery covered with clean linen coverings?

Ans. "No." 2, 3, 6, 7, 13, 14, 15, 17, 18, 19, 21, 23, 25, 28, 29. (15)

"Only head rests." 1, 5. (2)

"In summer season." 4. (1)

"Only in Officers' and parlor cars." 8. (1)

"In parlor and chair cars." 9, 26. (2)

"In chair cars." 10, 11, 22, 30. (4)

"Not in all cases." 12, 16, 20, 24. (4)

Q. 1-E. Are the windows shaded by curtains of smooth and non-absorbent material rather than slatted blinds?

Ans. "Slatted blinds." 1, 2, 8, 22, 29. (5)

"Curtains, mostly and preferably." 4, 5, 6, 13, 14, 15, 16, 18, 20, 21, 24, 25, 27, 30. (14)

"Both, old equipped with slats, new, with curtains." 3, 7, 9, 11, 12, 17, 19, 23, 26, 28. (10)

2. *Cleanliness of cars and furnishings.*

Q. 2-A. Are your cars swept and dusted periodically?

2-B. Are they swept and dusted only when, because of evident dirtiness, they are judged to be in need of such cleaning?

Ans. "Yes, at end of each trip." 1, 2, 8, 9, 17, 19, 21, 23, 24, 29, 30, (amounting often to several times a day.) (11)

"At end of each trip, and compressed air used." 3, 4, 10, 13, 30, "and at division points on long runs." 5. (6)

"At least once a day, and at end of trip." 6, 7, 14, 18. (4)

"Periodically." 11, 12, 15, 16, 26, 27, 28. (7)

"At terminals and in trains en route." 22. (1)

"As often, as thoroughly as possible, followed by compressed air." 20. (1)

Air blast is very generally used, and by the major part of the roads, although mention of the fact is not here made by respondents.

Q. 2-C. Are they swept and dusted with open windows?

Ans. "Windows open," or "windows and doors open," in all cases except 18. 27 reports "windows closed when sweeping is done en route."

Q. 2-D. Are their floors scrubbed or mopped periodically?

2-E. Are they scrubbed or mopped only when their appearance indicates the necessity for such cleaning?

Ans. "Yes, at the end of each trip." 1, 3, 4, 13, 17, 21 ,22, 24. (9)

"Scrubbed or mopped at end of each trip without the use of antiseptics twice a week." 2; "daily." 7, 25; "periodically" 10, 11, 12, 14, 15, 16, 19, 20, 26, 27, 28. (11)

"Scrubbed weekly, mopped daily." 18. (1)

"Mopped each trip, scrubbed when really dirty." 23. (1)

"When necessary." 29. (1)

"Washed at end of each trip with antiseptics." 5, 6. (2)

"Every lay-over day." 30. (1)

Q. 2-F. Are antiseptics used in the water employed for such cleansing?

2-G. If so, what is the material used, and what the strength of the solution?

Ans. 'Yes.' 20. (1)

"Yes, when necessary." 13. (1)

'No." 2, 3, 7, 9, 10, 11, 12, 16, 18, 19, 21, 23, 24, 25, 27, 30. (16)

"Floors, bottoms of car seats and cuspidors; thermoyl; one quart to fifty gallons of water. 1. (1)

'One gallon of purifine to twenty gallons of water." 4. (1)

"Zenoleum, two table spoonfuls to a bucket of water." 5. (1)

"Occasionally, carbolic acid, one ounce to a pail of water." 6. (1)

"Water two-thirds, disinfectant one-third." 8. (1)

"Learned's Disinfectant in all water used for washing floors, etc." 14. (1)

"Germol, one part to fifty parts of water; one-fifth for closets, one-tenth for floors." 15. (1)

"In case of known infectious diseases, corrosive sublimate, four tablets to a pail of water." 17. (1)

"Hot potash, floors and closets; two and one-half pounds of potash to four gallons of water." 26. (1)

Q. 2-H. Is the furnishing of the car, such as seat frames and upholstery of seats, carpets and draperies, cleansed by airing and beating with windows open, or when removed from the cars?

Ans. "Cleaned with compressed air, carpets removed." 1. (1)

"Seats and carpets removed for cleaning." 2, 3, 7, 17, 18, 23, 24, 26, 28, 30. (10)

"Carpets only removed." 4. (1)

"Seats removed and beaten at end of run." 5. (1)

'Seats removed periodically and beaten in repair shop, air blast on seat backs." 6. (1)

"Seats and backs inside, carpets outside." 21. (1)

"Seat bottoms, carpets and curtains removed from car and cleaned with compressed air at the end of each trip. Seat backs treated with compressed air." 8, 10, 15. (1)

"Cleaning done both inside and outside." 9, 19. (14 with compressed air.) (3)

"By air blast and removed when done." 11. (1)

"Cleaned in car." 12, 13, 16. (3)

"Seats and backs removed." 20. (1)

"Seats always taken out at terminals and thoroughly beaten and aired. Cars blown out with compressed air at cleaning stations when practicable." 22, 30. (2)

"Seats removed and cleaned outside the car and dusted with air blast. In old cars backs are cleaned inside, in cars of new pattern backs are removed and cleaned outside. 25, 29. (2)

Q. 2-I. Are the cars fumigated periodically, or treated with antiseptic vapors or fumes? If so, what is the material used, and what the process prescribed?

Ans. "In special cases. Formaldehyde." 5, 8, 20, 25, 31. (4)

"By material sent in such cases" 1. (1)

Disinfecting material, name unmentioned." 13. (1)

"No." 2, 3, 4, 7, 11, 14, 16, 17, 18, 19, 21, 22, 23, 24, 26, 27, 29, 30. (8)

"The coaches of this Company's system have not been fumgiated, the general cleanliness of the cars not making fumigation necessary; but personally I am inclined to think the idea is a good one worth adopting." 6. (1)

"When passing through epidemic territory." 9. (1)

"Red Cross disinfectant in saloons, and interior sprayed with sunol and phenosote." 10. (1)

"Closets only." 12. (1)

"At six day intervals sprayed with germol." 15. (1)

"Periodically with sulphur and formaldehyde." 29. (1)

Q. 2-J. Is the bedding, including blankets, mattresses and pillows, periodically or occasionally treated in the same manner?

Ans. "Removed beaten and cleaned with air blast." 1, 30. (2)

"Under Pullman or Wagner care." 3, 5, 12, 21, 25, 29. (6)

"No." 4, 18, 27. (3)

"Yes." 15. (1)

"In known cases of contagious diseases." 13. (1)

"Periodically or occasionally steamed or otherwise cleansed." 17. (1)

"Aired and sunned every four days." 23. (1)

"Official cars only are furnished, and these are frequently cleaned by airing." 22. (1)

"Periodically cleaned outside the cars." 26. (1)

Q. 2-K. Is the bed linen sterilized in boiling water in the laundry or elsewhere?

Ans. "By outside laundries." 1. (1)

"Under Pullman and Wagner care." 3, 5, 12, 13, 21, 25, 29. (7)

"In Company's (?) laundries." 4, 6, 10, 22, 23, 27. (6)

"Sterilized in boiling water in laundry." 8, 15, 17, 18, 20. (5,
"Linen sterilized periodically." 26. (1)
Q. 2-L. Are bedding and bed covering sterilized?
Ans. "Yes." 4, 8, 10, 15, 23. (5)
"Under Pullman and Wagner care." 3, 12, 13, 21, 25. (5)
"Occasionally." 17. (1)
'Daily." 18. (1)
"By laundry and formaldehyde." 20. (1)
"Linen periodically." 26. (1)
"Nothing has been done at this end of the line." 22. (1)
Q. 2-M. Are the sanitary fixtures treated periodically or occasionally with antiseptics?
Ans. "Yes." 2, 3, 4, 7, 10, 15, 16, 23, 27. (9)
"Cleaned with soap." 1. (1)
"Washed with water and zenoleum; five drops in drip pan after washing. 5 (1)
"Hot water and soap after each trip." 8. (1)
"Stationary disinfecting fixtures." 9. (1)
"No." 11, 17, 18, 19. (4)
"Washed with soap and water and wiped dry." 12. (1)
"Scrubbed with soda and borax." 20. (1)
"Water and hot potash." 26. (1)
"By Pullman and Wagner Companies." 21
"At arrival at terminal treated with ozonite disinfectant." 24. (1)
"Washed with boiling water and polished at end of each run." 25. (1)
"With solution of carbolic acid." 29. (1)
Q. 2-N. Are the sanitary fixtures treated periodically or occasionally with antiseptics?
"Cleaned and sprinkled with 'Solution No. 2.'" 1. (1)
"Yes, daily," 2, 14, 31. (3)
"Yes, periodically." 4, 5, 6, 7, 9, 10, 15, 17, 19, 23, 26, 27, 28, 29. (14)
"Occasionally." 13, 16. (2)
"After trips carbolic solution." 8, 12, 20, 22. (4)
"Continually." 21. (1)
"Only thoroughly cleaned."24. (1)
"Periodically treated with the Pennsylvania R. R. Company's disinfectant." 25. (1)
"No." 11, 18. (2)
3. *Cleanliness of air.*
Q. 3-A. Does compulsory practice insist on ventilation.
Ans. "Yes." 1, 3, 5, 6, 9, 10, 12, 14, 15, 16, 18, 19, 21, 22, 24, 25, 26, 27, 29, 30. (20)
"No."4, 7, 11, 13, 23. (5)
Q. 3-B. What has proved the most satisfactory method of ventilation that you employ?
Ans. "Roof." 3. (1)
"Deck sash and transom." 4, 30. (2)
"Deck sashes." 5, 6, 8, 10, 13, 16, 18, 21, 23, 28, 29. (11)
"Deck sashes and screened side windows." 9. (1)
"Deck sashes and hood screens that open to fan light at end." 12. (1)
"Pullman tip deck sash ventilator." 14. (1)
"Drop and trailing sash in clear story." 19. (1)
"Clear story and end doors." 24. (1)

"We have experimented and developed a system of ventilation which promises very good results, and is a great improvement over former methods. This system consists in taking air in at diagonally opposite corners of the cars through a hood, and by means of a downtake underneath the floor of the car to the space bounded by the outside sill, the first intermediate sill, the floor, and the false bottom. This space extends the whole length of the car on each side. From this space the air passes up through the floor into the heater boxes, the aperture in the floor being twelve inches long by two inches wide, and being located between all seats on both sides of the car. In the heater boxes the air is warmed, and from these boxes under every seat the air passes out into the car and finally to the outside through the ventilators in the deck of the car." 25. (1)

"Consult the wishes of the majority of passengers in the car." 26. (1)

Q. 3-C. What are the results in air quality as shown in chemical tests, if such have been made, or as indicated by the general sense of air quality?

Ans. "Good." 10. (1)

"We have little data as to the results with former systems, but with the last named it is clear, and is noticed not only by the train people, but by the general public, that the cars fitted with this system (as above described) are better ventilated than other cars on the same train, both in summer and in winter. The amount of air that passes through the car in moderately cold weather when all the passage-ways are open is about 60,000 cubic feet per car per hour. This amount of air is readily warmed by the heating system, except possibly in the most severe weather, and means are provided by which the amount can be reduced in severe weather, so that the temperature of the car is kept satisfactory. Analysis of air from these cars, when loaded to their full capacity, shows as the mean of several determinations under slightly different conditions, from 0.16 to 0.20 per cent. of carbonic acid, or, excluding the carbonic acid in the air to start with, from 0.12 to 0.16 per cent. coming from the passengers." 25. (1)

"Have not any chemical analysis to submit. After car is cleaned general sense of perception indicates air is relatively pure. After car has made a trip of one hundred miles or upwards, such general sense indicates that air is impure and bad." 29. (1)

Unanswered, or no tests reported by the others.

Q. 3-D. Is the temperature of the air closely regulated?

Ans. "Yes." 1, 2, 8, 9, 10, 12, 14, 15, 18, 19, 21, 22, 24, 26, 27. (15)

"No." 3, 11 13. (3)

"To suit the comfort of passengers." 4, 7, 16. (3)

"Try to." 5, 23, 30. (3)

"Closely as possible." 6. (1)

"In cars heated by steam and not provided with the ventilating system above described, it is difficult to regulate the temperature. Cars heated by the Spear stoves, and also in the cars which have the ventilating system above described, it is easy to regulate the temperature to any desired point, and a careful attempt is made to do this in actual practice." 25. (1)

"A normal temperature of 70° is maintained." 70. (1)

Q. 3-E. If so, is it done by trained men or by automatic means?

Ans. "By trained men." 1, 2, 4, 5, 6, 7, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24, 26, 27, 28, 29, 30. (23)

"By thermometer, one in each car." 8. (1)

"Trained men and thermometers." 9, 10. (2)

"It is done by trained men, each car being provided with a thermometer, and the trained men have instructions to keep the temperature as near as possible to 70° Fahrenheit." 25. (1)

Q. 3-F. With what satisfactoriness of result?

Ans. "Very good." 19. (1)

"Good." 8, 9, 10, 18, 27. (5)

"Generally satisfactory." 4, 12, 22, 23, 26. (5)

"To a degree only." 5. (1)

"Satisfactory in a general way." 6, 15. (2)

"Depending on the whims of passengers largely." 14. (1)

"Depends on the wishes of the passengers from time to time. The company cannot carry out any systematic plan against the wishes of the traveling public." 17. (1)

"Hard question. What will suit one person will be totally unsatisfactory to another in same car. No matter what effort is made to regulate temperature complete satisfaction will not be given to every person in the car." 21. (1)

"With proper care the result is fairly satisfactory with any system, but with the system of ventilation described, the results are very satisfactory." 25. (1)

4. *Cleanliness in water and foods.*

Q. 4-A. What precautions are taken to insure wholesomeness of water?

Ans. "Tanks thoroughly cleaned. Water taken on trains where it is known to be of good quality." 1. (1)

"All possible." 2, 5. (2)

"Water taken from cisterns or approved water works." 3. (1)

"Constant care and cleansing of tanks." 4, 15. (2)

"City supply." 6, 7, 8, 16, 21. (5)

"Boiled filtered drinking water." 9. (1)

"Coolers thoroughly washed each trip and good water supplied. 10, 12, 13, 22. (4)

"Best possible supplied." 15, 17, 18, 24, 26. (5)

"Satisfactory source of supply and cleanliness of vessels." 19. (1)

"Filtered water at terminals." 20. (1)

"Coolers emptied and fresh water at end of each trip." 23. (1)

"Chemical analysis made of water wherever any suspicious circumstances arise in regard to any source of supply." 25. (1)

"Filtered." 26. (1)

"Water tanks drained regularly and cleaned." 28. (1)

"Cooler washed out and ice applied previous to each trip." 29. (1)

"Tanks washed out and filled with ice, then water applied." 30. (1)

Q. 4-B. What to ensure the purity of ice?

Ans. "Manufactured ice, or ice from clean streams and lakes, and thoroughly washed." 1. (1)

"Made from distilled water." 2, 8, 20. (3)

"None." 3. (1)

"Mountain ice well washed." 4, 13, 18, 28. (4)

"Harvest our own ice, cleanest obtainable." 5. (1)

"Lake Champlain ice, thoroughly rinsed." 6. (1)

"From lakes along the line of the road not contaminated by sewage." 7. (1)

"Manufactured ice, handled with ice tongs only." 9. (1)

"Best obtainable, handled with ice tongs." 10. (1)

"In general, passengers are supplied with ice made from distilled water at an ice plant." 25. (1)

"Best obtainable." 11, 17, 26. (3)
"Washed before using." 12, 29. (2)
"Ice from ponds." 14. (1)
"Knowledge from where obtained." 15. (1)
"Ice examined and passed on by competent men." 19. (1)
"From lakes and pure running streams." 21. (1)
"Artificial ice." 22, 23, 27. (3)
"Good ice cut by our own force." 24. (1)

Q. 4-C. Are water coolers, cups, glasses, etc., frequently thoroughly and antiseptically cleansed?

Ans. "Yes." 1, 2, 10, 12, 16, 18, 20, 22, 23, 28. (10)
"Washed without the use of antiseptics." 3, 4, 5, 6, 7, 13, 15, 17, 19, 21, 25, 27, 29. (13)
"After each trip." 8, 24. (2)
"Washed daily." 9. (1)
"Periodically cleaned." 26. (1)
"Frequently cleaned." 30. (1)

Q. 4-D. What precautions are taken to protect foods, such as fruits, from disease germs which may be collected upon their surface when exposed in market or street stalls?

Ans. "Kept in closed refrigerators." 1. (1)
"Every precaution." 2. (1)
"Not under company management." 3, 6. (2)
"None." 5, 12, 17, 23, 24, 25, 27. (7)
"All fruits except grapes are thoroughly wiped before being served." 18, 21, 29. (3)
"Inspection of food, fruits, etc., very rigid." 26. (1)

Q. 4-E. Is the pernicious habit of spitting forbidden under penalty in the cars or about the premsies under your control?

Ans. "No." 1, 3, 7, 8, 11, 12, 13, 15, 16, 19, 21, 23, 25, 26, 27, 28. (16)
"No law of prohibition." 2, 5, 6, 17. (4)
"Notices posted in cars and about all buildings. No penalty on passengers." 20. (1)

Q. 4-F. Are suitable cuspidors furnished smoking cars or apartments, and are they frequently cleaned and disinfected?

Ans. "Yes." 1, 3, 9, 11, 13, 15, 16, 17, 19, 20, 21, 26, 27, 29, 30. (15)
"Cleaned every trip." 5. (1)
"Not smoking cars but smoking apartments, and frequently taken care of." 6. (1)
"No." 7, 12, 14. (3)
"Smoking and chair cars furnished with cuspidors." 10. (1)
"Every seat furnished with spittoon." 9. (1)
"In compartment cars, cleaned daily, not disinfected." 18. (1)
"Chair cars only regularly cleansed and disinfected." 22. (1)
"Smoking compartments provided with cuspidors." 23. (1)
"Cleaned each trip." 24. (1)
"Cocoa matting in aisle used for sputum receptacle, periodically removed and thoroughly scrubbed and replaced." 25. (1)

Q. 4-G. Are the same regulations enforced in all particulars relating to cleanliness of premises, air and foods in the railway stations under your control which are insisted on in the case of day, parlor and sleeping coaches?

Ans. "Yes." 1, 2, 7, 9, 14, 17, 21, 25, 27, 28. (10)

"In the larger stations care is exercised to secure cleanliness and proper ventilation." 3. (1)

"In larger stations." 5. (1)

'Periodical inspections." Ordered kept clean." 8, 24. (2)

"Terminal stations not under Company's control. Country stations receive no special attention." 11. (1)

"Stations kept clean and disinfected periodically." 19. (1)

"No control." 23. (1)

"As far as possible." 26. (1)

A full communication has been received from the Lake Erie & Western Ry. Company too late to be included in the above tabulation. This company reports, "Hard and non-absorbent material used in interior construction of coaches; recesses, grooves, pockets, etc., not wholly absent; seats made with removable backs and bottoms; and with reference to the minimum retention of dust; linen coverings used in chair cars only; windows shaded with curtains in chair cars and sleepers, slatted blinds in coaches; cars swept periodically and with open windows if weather permit; floors scrubbed or mopped periodically without the use of antiseptics; car furnishings cleaned with open windows, not fumigated; bedding, etc., aired in sun at intervals; bed linen and bedding not sterilized; toilet furnishing and fixtures kept clean by scrubbing; trained men are instructed to properly ventilate cars, for which deck lights are used; no chemical test of ventilation made, but results are considered fairly good; temperature controlled by trained men with fair results; no special precautions taken to insure wholesomeness of water or of ice, but best obtainable used; water coolers, cups, glasses, etc., not antiseptically cleansed; spitting penalty cannot be enforced against passengers; suitable cuspidors are furnished in smoking apartments and are properly cleansed; stations are in a general way cared for as cars."

A letter received from the Master Mechanic of one of the well-known railroads seems of sufficient interest and importance to be laid before you as suggestive of the opportunity open to the Association for the diffusion of correct and useful knowledge:

"In the avoidance of dust and dirt accumulation and their liability to carry diseases, finishing the cars as we do with varnish or paint, carry with them one of the best antiseptics known, that is turpentine, as the preparation both inside and outside of coaches depends greatly on the use of turpentine, as all the paints or varnishes are, more or less, composed of that material.

"In the dusting of our cars we use air in every case. Making no difference whether we remove the seats or backs and clean them outside again, or if they are cleaned inside the coach. This makes a very thorough dusting, and if possible to remove dirt or dust, the air is sure to accomplish it.

"Our upholstering is not covered with linen, such covering being only used in our sleeping cars.

"Speaking of shades or curtains. No curtain that is prepared for coaches has any turpentine, while the slatted blinds are prepared in the same way that the bodies of the coaches are, with turpentine material. Cleanliness of cars and furnishings depends on our men, who have strict orders as to how it should be accomplished which embraces the wiping off with alcohol or hot water and soap, the window frames, arm rests, wooden edges of seats (if there are any), sides of cars, scrubbing of the steam pipes with hot water and soap, as well as the floors. This they are instructed to do twice a week, and are mopped out at the end of each trip, except in muddy weather, when they are washed out daily.

"In the case of fumigation, we do not follow this system, although we are prepared at Atlanta for formaldehyding our equipment at any time in case of infectious diseases.

"The question of bedding and bed linen and covering belongs to the sleeping cars. Our toilet rooms and closets are thoroughly cleaned with carbolic acid, costic soap, and soap and water to insure their cleanliness; this is done at the end of each trip by orders, consequently is not optional with the men.

"In reference to the ventilation. This has been a sore subject with the railroads for the last fifteen years. The traveling public, where they have the means, invariably go well dressed, and to insure that they will be warm enough, in many cases carry a surplus of wearing apparel; those who unfortunately may be limited in their wardrobes are sometimes very scantily protected from the cold. To such extreme conditions existing in the same coach necessarily cause a difference in ventilation, the passenger who is heavily clothed insisting that the car is too hot and promptly opens wide the most convenient window, while the passenger whose wearing apparel is not so heavy constantly complains that the car is not sufficiently heated. Between these two factors our trainmen struggle to find a satisfactory medium, and I am sorry to say in most cases their labors are in vain, for no amount of steam heat will warm a coach where the two doors and two or three windows are open when the temperature outside indicates twenty or thirty degrees. It is also a recognized principle in ventilation that to insure same there must be a general current upward. This in accordance with the laws of nature; the air becoming heated by artificial means within the body of the coach or from the heat radiating from the human body, arises to the roof with a warmer current of air or body. At the roof it can be readily permitted to escape without interfering with the temperature to any appreciable extent, but the furnishing of this cold current of air to the lower part of the car necessarily disturbs all the heavy dust that, through gravity, seeks the lower part of the car, and in doing this they carry with them the germs of diseases. Any artificial means to produce this current but adds to the trouble.

"I heartily approve the recommendation of gum foot mats for cars; these are much more easily kept clean than other mats and do not

absorb the sputum and afford the same facility for removing from the car and thoroughly cleansing the outside."[1]

The too frequent irregularity in the temperature of cars, and the very frequent high and debilitating temperatures found in them are matters of common knowledge and complaint. When cars unattended are stalled in yards, and heat from steam mains applied preparatory to the making up of trains, it frequently happens that passengers on entering such trains find the air stifling and of ovenlike oppressiveness. Complaints due to long-continued discomfort of this sort on some roads has led your Committee to inquire into results attending the use of automatic means for the control of temperatures in cars. Reports of trials of regulating thermostats made in cars of the C. & M. W., Michigan Central, C., M. & St. P., Pennsylvania and Northern Pacific railroads are at hand. The temperature regulating service seems to have been installed for trial and inspection purposes by the makers, the Powers Regulator Company, and the records appear to have been taken either by the train attendants, or by the agents of the Regulator Company, and vouched for by the railroad employes. In these records the absence of high temperatures is noticeable. In one case the temperature range during the run from 8 A. M. to 5 P. M. was kept within the maximum and minimum limits of 71° and 68°. In another run from St. Paul to Portland, Oregon, the range held within the same limits, except as the cars were cooled for sleeping. In another run from St. Paul to Portland, Oregon, the range held within same limits except as the cars were cooled for sleeping. In another record the setting of the thermostat for day and night temperatures caused the range of temperature to be as above in the daytime, and at night from 62° to 65° in the berths. Automatic temperature control would seem as applicable to cars as to buildings, and the advantage in the matter of comfort and health of passengers, and in the economy of generating and using heat would appear to be as great in the one case as in the other.

It is with much satisfaction that your Committee report the order issued by the Pennsylvania R. R. Company management that all day coaches hereafter built for its service shall be equipped with the system for ventilation described in the report rendered last year to the Association. The suggestion is offered that prints and text descriptive of this method be sent by the Association to all railroad managements of the continent.

[1] Letters received from the Chicago, Burlington & Quincy R. R. Co.; the Delaware & Hudson River R. R. Co.; La Campania del Casuino de Fierro Nacional Mexicano, Campania Senictada del Ferrocarril—Central Mexicano—have been received too late to report their contents. That of the first-named Company is of special interest and in the next report will receive the consideration it merits.

Since the rendering of the last report one, if not the largest terminal station in the world has been opened for use in Boston. It is gratifying to note the great attention given in the construction and equipment of this station to sanitary matters, in the thorough and generous ventilation of all rooms, and the especially effective ventilation provided for all sanitary rooms, the pure quality of the manufactured ice furnished cars, and the prohibition of spitting. An advanced standard has been set which is likely to have an educative effect and influence on all future work of a similar kind. It is understood that Pittsburg is soon to have a terminal station equally well furnished.

To your Committee the outlook is an encouraging one. Railroad managements are for the most part ready to provide all reasonable means for the comfort, health and safety of their patrons. Many of them would be pleased to know the surest and most practicable way of meeting the hygienic requirements this Association is seeking to establish. State and other health boards appear ready, and in some instances are waiting to co-operate with the American Public Health Association. Railroad managements and trade organizations connected with railroads, listen respectfully, intelligently, and with increasing sympathy to addresses made on hygienic themes. It is hoped that the evident progressive movement apparent all along the line will not suffer check through inaction on the part of this Association.

Respectfully submitted,

S. H. WOODRIDGE,

Chairman.

DANGERS TO THE PUBLIC HEALTH FROM ILLUMINATING AND FUEL GAS.

By WM. PAUL GERHARD, C. E.,

Consulting Engineer for Sanitary Works.

At the last annual meeting of the American Public Health Association a Committee was appointed to investigate the subject of illuminating gas in relation to health. This subject is now, owing to recent progress in the art of manufacturing gas, much more difficult to treat than it was twenty or thirty years ago, when scarcely anything else but the ordinary lighting gas, manufactured by a process of distillation from coal, was known. About twenty years ago, gas companies began the manufacture and introduction of the so-called water gas. Several investigations were conducted and reports made at that time[1] with regard to the dangers involved in the new gas. Still more recently, not more than five years ago, the manufacture of acetylene gas from calcium carbide began, and while its use at present is largely confined to isolated buildings not in reach of city gas works, it promises a rapid development within the next decade.

To discuss intelligently a subject of such great importance and to make the work of the Committee effective, an intimate knowledge and practical experience in the manufacture and distribution of gas, in the work of piping houses for gas and in the different uses of gas are necessary. It would therefore seem to me best to place on the Committee a chemist, or chemical technologist acquainted with all methods of generation, purification and analysis of gas; an engineer, either a gas engineer or a sanitary engineer who has made a specialty of the entire subject of domestic and street gas piping and gas lighting; and finally a physician, health officer or sanitarian, well acquainted with the sanitary features and requirements of lighting, with the unhealthful effects due to the combustive processes, and the dangers due to gas escaping unburnt.

The æriform mixture, commonly known as "gas," is nowadays used not only as an illuminant, but also as a fuel (for heating, cooking and

[1] Dr. Sam'l W. Abbott. The Relation of Illuminating Gas to Public Health, 6th. Annual Report Massachusetts State Board of Health, Lunacy and Charity, 1885.

Profs. Sedgwick and Nichols, A Study of the Relative Poisonous Effects of Coal and Water Gas, same Report, 1885.

Prof. Edw. S. Wood, Illuminating Gas in Its Relation to Health, Vol. III, Trans. A. P. H. A., 1877.

Dr. Jos. H. Raymond, Illuminating Gas; Its History and Its Dangers. Tenth Annual Report State Board of Health, New Jersey.

Report of the Commissioner of Health of Brooklyn, on Illuminating Gas, 1883.

industrial purposes); in a few cities a special quality of gas not fit for illumination, is distributed to consumers for use as gaseous fuel; in other cities what is known as natural or rock gas is introduced into houses for like purposes, hence the scope of the Committee's work might perhaps be enlarged by either omitting the word "illuminating" before the word "gas," or else calling it "illuminating and fuel" gas. For other reasons it might be advisable to omit the words "leakage from," and to call the subject "Dangers to the Public Health from Illuminating and Fuel Gas."

By way of introduction, the different known kinds of gas, their manufacture and composition should be briefly reviewed; likewise the usual impurities found in them, and particularly their dangerous or poisonous ingredients.

From a sanitary point of view, it is important to consider not only the dangers incident to gas escaping unburnt, but also the effects upon health due to the burning of gas.

Gas escapes and leaks may occur at the place of manufacture or the gas works, in the distributing system in the public streets, and finally at the places of consumption, in the houses or shops. The last subject is of particular importance, and should be more fully discussed under the headings of dangers due to the gas service pipes in houses, to the gas fixtures, and to the use and management of gas.

Following this, it is desirable to review the remedies and precautions suggested or enacted for the lessening of the dangers and fatalities due to gas.

DIFFERENT KINDS OF GAS, THEIR MANUFACTURE AND COMPOSITION.

At the present time, we may distinguish the following kinds of gas, viz.:

1. Natural gas.
2. Coal gas.
3. Water gas.
4. Carburetted or luminous water gas.
5. Air or naphtha gas.
6. Acetylene gas.
7. Gas from oil, wood, resin, etc.

Natural or *rock gas* consists of an accumulation of hydrocarbons found in nature below the surface of the earth. It sometimes flows freely at the surface, like the eternal gas fires at Baku, Russia, or else it is liberated by boring. It is really the same as marsh gas or light carburetted hydrogen, known in mines as fire damp. In burning it usually produces little light, the flame being bluish yellow, and is there-

fore suitable principally as fuel gas, though some natural gas contains illuminating or heavy hydro-carbons, and may be used for lighting. Mixed with ten times its volume of air, this gas ignites with a violent explosion, when a light is applied. The composition of natural gas varies, as seen from the following three analyses:

	I.	II.
Marsh gas	49.58	75.16
Hydrogen	35.92	14.45
Ethylhydride	12.30	4.80
Ethylene	0.60	0.60
Oxygen	0.40	1.20
Carbonic oxide	0.40	0.30
Carbonic acid		0.30
Nitrogen		2.89

	III.
Marsh gas	60-89
Hydrogen	4.79-22.5
Ethylhydride	4-18
Ethylene	0.56- 2.94
Carbonic oxide	traces to 0.26
Carbonic acid	0.28- 0.66

Coal gas is made from bituminous coal, by a process of distillation in closed retorts. It may be termed the ordinary illuminating gas, as it was the first lighting gas manufactured and distributed on a large scale. Such coal gas is really a more or less purified mixture of a number of distinct gaseous combustible substances, of which some are luminous, while others burn with non-luminous flame. Its manufacture embraces three principal processes, viz., the distillation, the condensation and the purification of the gas.

When coal gas is distilled in retorts, the resulting vapors which contain hurtful impurities are first condensed, and tar and water is thereby removed; the subsequent processes of condensation in condensers remove carbonic acid and some ammonia; in the washers and scrubbers ammonia is removed, while the purifiers free the gas of carbonic acid, sulphuretted hydrogen and other gaseous sulphur compounds, by means of lime and oxide of iron. The composition of purified coal gas is about as follows:

A few actual analyses of coal gas are here quoted, the differences being due to the kind of coal used in the manufacture of the gas.

I	II (Pettenkofer)	III
Hydrogen 50.2	49 per cent hydrogen	40-50 per cent hydrogen
Marsh gas 29.8	36 per cent marsh gas	35-45 per cent marsh gas
Carbonic oxide 7.9	7 per cent carb. oxide	4½-7½ per cent carbonic oxide
Heavy hydro-carbon 4.3	8 per cent heavy hydro-carbons.	4-8 per cent olefiant gas
Nitrogen 7.8		Small amounts of carbonic acid.
100.0		

Boston Coal Gas (Nichols).			London Coal Gas (Letheby).	
Marsh gas	40.0	37.41	Light carburetted hydrogen	39.5
Hydrogen	34.8	46.38	Hydrogen	46.0
Nitrogen	14.2	3.72	Condensible hydro-carbons	3.8
Carbonic oxide	7.0	5.53	Carbonic oxide	7.5
Illuminants	3.4	6.19	Aqueous vapor	2.0
Oxygen	0.5	0.25	Oxygen	0.1
Carbonic Acid	0.1	0.52	Nitrogen	0.5
			Carbonic acid	0.6

Water gas or *hydrogen gas* is made by passing steam over incandescent carbon or glowing coals. The resulting gas is odorless and non-luminous, but owing to its large amount of hydrogen it burns with great heat, hence this gas is excellent for fuel purposes. The coal used in the process is anthracite coal. Theoretically, water gas is composed of

50 per cent. hydrogen and
50 per cent. carbonic oxide.

It should be pointed out that pure water gas contains a very large proportion of carbonic oxide which is the dangerous element in all gas.

Carburetted or *luminous water gas* is a mixture of pure water gas and petroleum, naphtha or cannel gas, the latter gases being heavy hydrocarbons mixed with it to give it luminosity, to render it fit for lighting purposes and to give it a distinct odor. This is done by the so-called carburetting process. Since about twenty years a great many gas works (nearly two-thirds in U. S., according to Prof. Bunte), manufacture and supply this composite gas, the chief reasons for prefering this process being the reduction in first cost of the works, the easier purification, the smaller area required for manufacturing, the possibility of using coke, the doing away with some of the side products or residues, and the cheapening in the cost of manufacturing the gas.

There are many different processes in use for making carburetted water gas (Lowe, Strong, Gwynne-Harie, Harkness, Tessie de Motay), and the composition of the manufactured gas, as well as its lighting qualities vary greatly. A few analyses are quoted as examples:

Composition of Water Gas (Remsen). I		Water Gas of Municipal Gas Light Co. (N. Y.) II		(Wurtz). III	
Carbonic oxide	28.25	Hydrogen	38.05	Hydrogen	36.34
Illuminating hydro-carbons	12.82	Marsh gas	11.85	Marsh gas	20.55
Marsh gas	21.45	Carbonic oxide	29.40	Carbonic oxide	27.46
Hydrogen	30.3	Carbonic acid	0.10	Carbonic acid	0.35
Nitrogen	6.85	Oxygen	0.10	Oxygen	0.26
Carbonic acid	0.3	Nitrogen	3.71	Nitrogen	2.56
	99.97	Olefine	9.29	Illuminants	12.48
		Paraffines	7.50		
			100		

Air or machine made gas, or *carburetted air gas,* is a simple mixture of atmospheric air with the vapor of naphtha, benzol, petroleum or gasoline. The use of such gas is largely confined to the lighting up of isolated buildings not in reach of gas works. The apparatus for its manufacture consists, in its simplest form, of a blower and a generator. The latter is placed in a brick vault, at a good distance from a building, and is filled with refined gasoline, which is a very volatile inflammable liquid. A blower or air pump is placed in the cellar of the building; this is operated either by a suspended weight (which must be wound up same as the weights of a clock), or by a wheel driven by water. It forces air into the generator, which here takes up the vapors of the naphtha and returns so enriched to the house to be consumed.

It burns with a tolerably good luminous flame, the gas being very heavy, it flows more slowly, hence large pipes and burners are required. The flame is seldom free from smoking.

The gasoline itself from which the gas is made is a very volatile and highly inflammable liquid, which gives off vapors at ordinary temperature. Mixed with a certain proportion of air, the machine or air gas is very explosive.

Acetylene gas is the latest comer in the field of gas manufacture. This gas has been known chemically since 1836 (Edmund Davy, chemist), as the most brilliant of illuminating gases. In 1861 the chemist Wœhler, and later Berthelot, prepared the gas in the laboratory from calcium carbide and water. In 1894 the French chemist, Henry Moissan, made small quantities of calcium carbide in a laboratory furnace. Its commercial manufacture on a large scale in electric furnaces was discovered accidentally in 1892 by an electrician, Thomas L. Willson of Canada. Before that time, calcium carbide was a very expensive chemical, costing about $2000 per ton; after Willson's discovery its price immediately dropped to $70.

Acetylene gas has a very peculiar, easily detected garlic-like and unpleasant odor; it is an ignitable gas, rich in hydro-carbons, and is generated by bringing calcium carbide in contact with water. It is composed of 92.3 parts by weight of carbon, and 7.7 parts of hydrogen. Mixed with air, in a proportion from 1 to 4 up to 1 to 20, acetylene gas is very explosive, its explosive force being much stronger than that of coal or water gas. The more the gas is condensed, the more explosive it becomes, and in its liquefied form it is so dangerous that its use is at present everywhere prohibited.

The purity of acetylene gas depends upon the purity of the raw material from which it is made. Calcium carbide always contains phosphor, sulphur and nitrogen, and unless purified, the resulting acetylene gas will contain phosphoretted hydrogen, sulphuretted hydrogen and

ammonia. The improved processes of manufacture of calcium carbide do away with these impurities.

Purified acetylene is not as dangerous to breathe as coal or water gas; it takes also in burning less oxygen from the atmosphere, and creates much less carbonic acid in combustion than the ordinary gas. The gas is of a much higher luminosity than ordinary gas, burns with a white flame, and owing to its richness in hydro-carbons, special burners with small orifices or jets and burning only one-half cubic feet of gas per hour must be used; these give a light of about 25 candle power against the 16 candle power light of the ordinary 36 cubic foot burners.

The ammonia contained in acetylene gas will form a chemical explosive combination with copper, hence copper gas fixtures, piping or generators should not be used.

Numerous forms of apparatus for making acetylene gas have been devised. Practically, there are three types of generators: (*a*) Those in which a measured quantity of water is supplied gradually to a large volume of calcium carbide, contained in a closed vessel; (*b*) generators in which the carbide is immersed into water and then withdrawn, the action being repeated from time to time; (*c*) generators arranged so that a measured quantity of carbide is dropped into a large volume of water. The generator and the gasometer may be fitted up separately or together. From the point of view of safety it is advisable to place the generator in a brick vault, outside of a building (the same as with air gas machines).

Owing to the necessary use of very small burners, it will take a much longer time before a room, in which a gas cock is left open, will hold a mixture dangerous to health. The odor of acetylene gas being very peculiar and distinct, a small leak is rendered very noticeable.

Quite recently a new lighting gas made from pure acetylene gas by dilution has been used, as the following item from the *London Daily Mail* shows:

"The first place in the United Kingdom to be illuminated with the bright white light of "Electroid Gas" is Hunmanby, a Yorkshire village near Scarborough. This new illuminant is composed of acetylene with the admixture of inert matter and a proportion of oxygen. Its manufacture is claimed to be of the simplest nature. The gas can be delivered through any ordinary gas main at the ordinary pressure, measured by means of gas meters, and charged for in the same way as is the custom where ordinary coal gas is used. The light is described as perfectly white, and equal to 250 candle power, as against the average 17 candle power of coal gas."

According to an article by Dr. Paul Wolff in Glaser's Annalen für Gewerbe und Bauwesen, the town of Schönsee, in West Prussia is now supplied with acetylene gas from a large plant, designed for 2000 burners (*Eng. Record*, October 21, '99).

Gas is finally made from oils, melted fat, resin, petroleum, peat and from wood. Owing to the cost of these materials, only a few oil or wood gas works are in existence. Gas is made from petroleum or from naphtha by decomposing the same in heated retorts. Such gas requires no purification, is very rich in heavy hydro-carbons, but is too expensive to be sold in a commercial way. It is used more as a means to enrich the non-luminous water gas, and to render the same less dangerous in use by imparting to it a distinct smell.

IMPURITIES IN GAS—TESTS FOR IMPURITIES.

The gaseous impurities of ordinary coal gas are sulphuretted hydrogen, vapor of carbon disulphide, carbonic acid and ammonia. These reduce the lighting qualities of the gas and the sulphuretted hydrogen, in burning, produces sulphurous and sulphuric acid, which are destructive to metallic articles, plants and generally injurious. Sulphuretted hydrogen can be traced by holding a strip of paper, dipped in sugar of lead, which in the presence of this impurity becomes discolored and turns brown, the intensity of the latter color being an indication of the degree of impurity.

Carbonic acid can be detected by leading the gas through lime water, which thereby becomes cloudy or white. The presence of ammonia is indicated by dipping a glass rod in muriatic acid and holding it over an open gas burner, when a white fog will form.

The purification processes remove all but a small quantity of these gaseous impurities.

DANGEROUS OR POISONOUS INGREDIENTS IN GAS.

While sulphuretted hydrogen is a poisonous ingredient, the quantity contained in well-purified gas is so small that it may be disregarded. From a health point of view, the really dangerous poisonous ingredient of both coal and water gas is the carbonic monoxide. This is present in both kinds of gas, the amount in coal gas being from 7-10 per cent., and in carburetted water gas from 25-40 per cent. Chemistry teaches that carbon monoxide or carbonic oxide is a colorless and tasteless gas, a little lighter than air, which burns with a bluish flame forming carbonic acid. It acts as a strong poison, producing asphyxia and often death when inhaled in small quantities. Its toxic effect is due to a combination with the hæmoglobin of the blood, which is thereby rendered unfit to take up oxygen in the lungs.

In coal gas as well as in carburetted water gas the carbonic oxide is simply a diluent, the same as the marsh gas. It does not appear to be practically possible to remove it from ordinary coal gas, though it is stated that a part of it can be removed from water gas.

As regards danger from explosions the light carburetted hydrogen, and to some extent the olefiant gas or the heavy carburetted hydrogen, are the dangerous elements, for these mixed in certain proportions with atmospheric air, form a mixture which explodes when ignited.

DANGERS IN THE USE OF GAS.

When lighting gas was first made, objections were raised against its use, because of the products of illumination, when the gas was burnt. But nowadays it is a well-established fact that no serious danger to health, beyond the mere contamination of the air, results from the burning of purified illuminating gas. The contamination of the atmosphere can, of course, be counteracted by proper and sufficient ventilation. Theoretically the products of burning gas are only water and carbonic dioxide.

Unburnt gas, however, is dangerous, no matter how made. Escapes of unburnt gas are therefore to be avoided. The dangers are twofold, viz., first, asphyxiation, and second, explosions, the latter sometimes accompanied by fire. The danger of asphyxia is greatest with pure water gas, next comes carburetted water gas, then gas made from wood, coal gas, and finally natural gas. Neither the air gas nor the acetylene contain carbonic oxide, though the breathing of such gas may be injurious for other reasons. The danger of gas explosions, caused by mixtures of gas and common air becoming ignited, is present with all kinds of gas, though the proportions between gas and air, which are explosive, differ somewhat with the different kinds of gas.

Dangerous escapes of gas may occur either at the works where the gas is manufactured, or in the distribution system in the streets, or finally in the houses when the gas is consumed as fuel or as illuminant, or for power purposes. Gas escapes in buildings are either due to leaks, or to carelessness or ignorance in the use of gas, or accidents.[1]

DANGERS INCIDENT TO THE MANUFACTURE OF GAS.

At the gas works, where either coal or water gas or carburetted water gas is manufactured, the workmen are to some extent exposed to the danger of explosions due to escaping gas, and on the other hand are liable to suffer from breathing gas which may escape from the retorts, the gas holder, or at other points in the works. It is stated on good authority that accidents at gas works from the inhalation of coal or

1 Gerhard, W. P., Accidents With Gas. Amer. Architect, Aug. 6th, 1898.

water gas are comparatively rare. Where water gas is manufactured, there is of course a greater danger than with coal gas, owing to its larger percentage of carbonic oxide. Good ventilation in the gas works is always an essential condition. The workmen in gas works are also liable to suffer from exposure to the heat and from sudden changes of temperature. The ammonia of unpurified gas attacks the mucous membrane of the respiratory organs. Besides this, the workmen may suffer from the vapors caused by the extinguishing of the burning cokes, and in the purifying department workmen who clean and empty the lime boxes are liable to inflammation of the eyes from the gases and odors.

DANGERS INCIDENT TO THE DISTRIBUTION OF GAS.

The gas distribution system embraces the street mains, the house and lamp services and the gas meters.

There is always some leakage of gas connected with the distribution mains, the gas escaping either at the joints or from imperfect pipes, or finally from breaks in the mains. From 7 to 10 per cent. of the daily output is estimated to be lost by leakage from the gas mains.[1] Cases of asphyxiation occur when workmen make connections with the gas mains (so-called "tapping"), or when they go into trenches in which a broken gas main is to be repaired.

The chief danger connected with escapes of gas under the street surface is that the gas often finds its way through the soil and escapes into the houses located along the street. When such gas leakages occur, the peculiar pungent odor of the gas is sometimes partly or completely lost by filtration through the soil. Where this is the case, it is much more difficult to detect a leak or break, and the buildings and their occupants along the line of such defective or broken gas main become exposed to two grave dangers, namely, the danger of explosion and of asphyxiation. Many cases are on record of people having become asphyxiated in houses not provided with any gas service. This danger, as was first pointed out years ago by Prof. von Pettenkofer, is particularly great in winter time and this for two reasons: First, the street surfaces are apt to be frozen hard and will not permit the gas to escape upwards where it would do no harm and where it might be quickly noticed; then again it is well known that houses act in winter time like chimneys by reason of the temperature inside being higher than that outside, they therefore draw in the ground air, as it were, and with it the gas which has leaked into the soil. The dangers

[1] See *Scientific American* Supplement of Dec. 23. 1899; *American Architect*, Jan. 27, 1900, on Gas Conflagrations: Report of National Board of Fire Underwriters' Committee on Lighting and Heating, "On the Fire Risk of Gas Main Leakage under Impervious Street Pavements." All these articles appeared after this paper had been submitted.

are, of course, aggravated by the fact that at night, and in winter particularly so, the doors and windows of bedrooms are closed. Prof. von Pettenkofer relates a great number of instances where not only one person, but sometimes entire families, have been found in the morning asphyxiated by gas which had entered houses in this manner. Sometimes the gas escaping from the main will follow along the line of house sewers and will thus gain entrance to the cellars, in other instances it follows the tubes or conduits which enclose the electric light wires.

Where no asphyxiation occurs, dangerous explosions may happen by reason of the escaping gas mixing with the air. The striking of a match, or the bringing down into the cellar of an open flame will speedily cause this result. As I am writing this paper, a fatal gas explosion occurred in an uptown street in New York City, in a house which had not been occupied for the entire summer, but where a workman entered in the morning to make some improvements to the house. Five minutes after he was seen to enter the house, an extremely violent explosion occurred, which blew out the entire front and rear walls of a three-story brick and stone building, which caused a fire in this and several adjoining houses, and in which the unfortunate workman was killed. The cause in this instance was a broken gas main from which the gas had been escaping into the cellars of the houses along the street for probably many days or weeks.

The danger of being asphyxiated is in all such cases much greater where the gas manufactured is the so-called carburetted water gas. Where otherwise healthy persons, living in houses not supplied with gas, awake in the mornings with persistent headaches or nausea, it is always well to bear in mind the possibility of carbonic oxide poisoning from gas escaping in the manner described above.

In case of a break of a street gas main, the most important thing to do until the company can shut off the gas and reach the leak, is to keep open all windows of the cellars and basements, also to avoid having any open light.

It is difficult to suggest a remedy for the conditions named, except that wherever an escape of gas is noticed in a street it should be immediately reported to the gas company and they should act promptly in the matter, and if necessary, cut off the gas from the entire street rather than continue to expose houses to such dangers. A German chemist, Prof. Bunte, has suggested a ready method for testing the tightness of gas street mains at intervals of 6 to 10 feet along their line. Small holes from 12 to 16 inches deep are bored, and in each opening an iron tube one-half inch in diameter is placed which has within it a glass tube containing a roll of test paper. This paper is dipped into a solution of palladium chloride and any trace of gas escaping from the main at once

acts upon the paper, coloring the same a slight brown or even a black color according to the extent of the leak. If on the other hand, after say ten minutes, the paper remains white, it is a safe indication that at the point tested there is no escape of gas.[1]

To the distribution system belong also the house and lamp services and the gas meters. The house services should be laid with the same care as is required for the inside gas piping system (see appendix) and any leak which shows itself in the cellar at the point where the service enters should be at once repaired by notifying the company to whom the piping belongs. Breaks in services to street lamps are sometimes indicated by the fact that a street lamp suddenly burns very dimly.

The consumers' gas meters, which form the connecting link between the house service and the house pipes for gas, should also be tight and all connections made with the greatest care. Connections with iron pipes and fittings are preferable to those of lead.

Accidents sometimes occur to workmen of the gas company when replacing a defective gas meter or cleaning out house services that have become stopped up. In all such cases, the greatest care should be observed to avoid asphyxiation.

DANGERS INCIDENT TO THE GAS PIPING IN HOUSES.

In piping houses for gas it is always well to bear in mind the dangerous nature of the gas to be carried in the pipes. Of whatever kind the gas may be with which the house is to be lighted, whether natural gas, coal gas, water gas, air gas or acetylene gas, the piping should be absolutely tight in the joints and the tightness should always be ascertained by carefully testing the gas piping system after completion. (For a description of how to test the gas piping see the appendix.) It has been pointed out by scientific investigators, that even slight gas leaks in houses, when going on for a long time, will have an ill effect upon the health of the inmates. They will suffer not only from headaches, vertigo and nausea, but also in some cases from sore throats.[2] Quite often such gas leaks and their effects are erroneously attributed to "sewer gas." Larger leaks of gas are dangerous, first, by reason of persons becoming asphyxiated, and second, because the gas when mixed with air and brought in contact with a flame will cause explosions or a fire. Many accidents are annually recorded where persons have searched for a gas leak with an open light, and even mechanics, who should know better, at times risk their lives by this bad practice.

In laying out the gas piping system for a building, it is of the utmost importance to so arrange the pipes, in size and manner of distribution,

[1] Another method is suggested in Hartenfels' Patent Gas Leak Indicator.

[2] See Gerhard's "Gas Lighting and Gas Piping, New York, 1893."

as to avoid at any point in the system the possibility of a sudden reduction in the gas pressure, for where this happens a flame which has been turned down low is liable to go out, and when the pressure is re-established death by asphyxiation may result through the escape of the gas. Although this matter was not unknown, it has been pointed out for the first time, I believe by Mr. Faxon, an architect, of Boston. The matter will be referred to again under the heading of "Management of Gas."

It would require too much time to explain in detail how the gas piping of houses should be properly arranged. I have, therefore, in an appendix to this paper, given some suggestions which contain practically all rules which it is necessary to follow, to have a well-arranged gas piping system and to avoid the escape of gas from a defective house piping system. A few points of caution are here added: First, in piping a house always keep the gas pipes away from bell wires, for cases are on record where such bell wires in constant contact with the gas pipe have gradually cut the pipe, causing a hidden leak of gas which was often extremely difficult to find. Second, gas pipes should always be kept away from steam and hot water pipes, also from hot air flues, smoke pipes and from electric light wires.

Where small leaks of gas in the pipes of a house are suspected, a very simple method for detecting these is to watch the small index hand of the gas meter. Wherever this moves, when no lights are burning and no gas is used in the house, there must be somewhere a gas escape. Sometimes a gas leak may be noticed by a rumbling sound in the gas meter when all the burners are closed.

DANGERS INCIDENT TO THE GAS FIXTURES.

In the system of gas fixtures and appliances, in which gas is either burned for illumination or else for cooking or heating purposes, there are quite a number of points which require serious attention. First, there is the joint where the fixture is attached to the gas piping or to the gas outlet. Except for the few temporary connections by means of rubber tubing, this joint is nearly always a fixed joint. It therefore requires to be made with the same care as any other joint in the pipe system, but the makers of gas fixtures, who usually attach the latter, are very often guilty of carelessness or bad workmanship.

Next come the fixtures themselves. Of whatever material they are made, the tubing through which the gas is conveyed to the point where it is burnt, should be absolutely tight. It would be well, if all gas fixtures were tested before leaving the factory, for owing to the fact that the gas keys are seldom absolutely tight, it is a difficult matter to test the gas fixtures in a house after the fixtures are once connected.

The gas keys or "taps," which govern the flow of gas, are very often found to be loose in the joint or else worn out, and in that case a constant, though small, escape of gas may result. Keys which turn too hard are equally bad, as accidents may happen by reason of the gas not being entirely shut off. Numerous fixtures have either folding, or extension, or telescopic joints. All such joints constitute places where an escape of gas may occur. Particular attention should be called to the danger of old-fashioned gas fixtures with so-called "all around" cocks, that is, having keys without stop pins. The writer has held long ago that the use of such fixtures should be prohibited by legislative act. Where the keys are provided with pins, these are often made of too light material and break or snap off. The joints of extension fixtures should be watched with particular care. So-called water-joint pendants are liable to have the water evaporate and it is best to substitute glycerine for the water. Very often the tubing of chandeliers corrodes and splits and gas leaks result. Where portable table lamps are used, the rubber tubing may become worn out or cracked, and permit gas to escape.

All gas keys should be properly greased and loose keys should be tightened to avoid the slightest smell of gas. The joint where the gas burner is attached to the fixture should also be made tight, as it otherwise may leak gas when the same is turned on.

Accidents may occur from all the causes named. In the Massachusetts statistics of deaths from asphyxiation, a few other causes are pointed out of which the following may be mentioned: Combination gas and electric light fixtures in which the gas key may be turned on, being mistaken for the electric light key. The use of so-called independent cocks is also somewhat dangerous when the two keys are placed close together, one of them controlling the light and the other a connection to a gas stove, as the one may be turned open by accident when the other is closed.[1]

Heating and cooking fixtures must also be connected with care and must not have any leaky places. Where rubber tubing is used for temporary connections, accidents may occur from the same slipping off the joint, or breaking off near the same, or becoming sufficiently loose to permit an escape of gas.

Where gas pressure regulators are used at the meter to control the gas pressure, these should be carefully examined for tightness, for very often slight leaks are found in such appliances.

Each single leak may be ever so small, yet the aggregate of such leaks in a house may lead to a serious contamination of the air and to

[1] See *Accidents with Gas*, by Wm. Paul Gerhard, Am. Architect, Aug. 6, 1898.

the bad effects on the health of the occupants due to slow poisoning referred to above.

DANGERS INCIDENT TO THE USE AND MANAGEMENT OF GAS.

Numerous accidents occur annually in the use of gas for lighting, cooking or heating, through either carelessness or ignorance.

The largest number of accidents, probably, occurs from ignorant persons either blowing out the gas, or turning the same out and subsequently turning the cock on sufficiently so for the gas to escape unnoticed. This is particularly liable to happen in hotels and lodging houses, where persons from remote country districts, or emigrants, who have never used gas before, take rooms, but it also happens now and then in private families in the bed-rooms of servants not acquainted with the use of gas. Fatal accidents usually occur in small rooms having no ventilation, during the sleep of the occupants.

Many other accidents are the result of the bad practice of turning down a gas flame, particularly in a bed-room. This is always ill-advised, for such a turned down flame may be either blown out by a draught of air from an open window, or else it may be extinguished by a sudden variation or reduction in the pressure. When this happens in a small bed-room without ventilation, there is great danger of persons becoming asphyxiated, particularly so if water gas is used. Much can be done to avert this danger by a proper arrangement of the gas piping in houses. (See Appendix.)

Another dangerous custom is to shut off the gas at the main service or at the gas meter during the night and numerous accidents, some of them fatal, have resulted therefrom. It is almost equally bad to turn off the gas at the meter during the day.

Notwithstanding the universal introduction of gas lighting, there are still numerous persons who would be benefited by receiving plain instructions on the use of gas in the household. Gas companies would benefit themselves and the public by paying more attention to this matter.

Among the statistics already quoted may be found numerous incidents of deaths or accidents due to faulty management of gas. Among the more remote causes I find the following mentioned, namely: Two adjoining rooms supplied with gas from one so-called pre-payment gas meter. In one of these rooms a man retired for the night when the gas supply from the meter was exhausted, but forgot to close his gas burner. The occupant of the adjoining room came home late at night, dropped a coin in the slot of the gas meter and got a fresh supply of gas, which meanwhile also escaped in the adjoining room, killing the occupant.

Escape of gas and explosions have also happened in the use of gas cooking stoves, where the boiling water running over the vessel extinguished the flame. It has already been mentioned that the so-called independent gas connections with two keys may lead to accidents by the wrong one being turned by mistake.

Where the gas in the cellar freezes in the winter time, it is dangerous to attempt to thaw out the gas meter or service with a flame. A gas meter should never be examined with a burning light, nor should any tools be used near a gas meter known to be leaky, on account of the danger of flying sparks.

REMEDIES SUGGESTED,

According to the official statistics of the Board of Gas and Electric Light Commissioners of the State of Massachusetts, 105 gas accidents occurred in the year 1897, causing 60 deaths and 74 injuries. In the year 1898, 101 accidents occurred, causing 77 deaths and 45 injuries. While a portion of these deaths are due to suicidal intent, the majority of cases were accidents which might have been prevented by a stricter inspection of the gas piping and fixtures.

It cannot be overlooked that the danger is a serious one and one that is sure to increase as the use of carburetted water gas becomes more universal. Without a desire to draw comparisons as to the relative dangers from sewer air and from illuminating gas poisoning, I have always held the view that both are equally preventable by proper supervision of buildings, old and new.

In recent years the supervision of gas piping and gas fittings has been agitated in numerous places, among others in Boston, New York, Philadelphia, and in Washington. In the first named city this agitation has resulted in the enactment of laws governing gas piping and the inspection of such work in all new buildings. A similar law was introduced a few years ago in Albany, but for reasons hard to conceive the bill was killed.

Among the remedies to be applied I would mention the following:

First. The enactment of official regulations regarding the arrangement of the gas pipes in buildings and the provision for official municipal inspection and for testing all work in connection herewith. It is advisable that all manufacturers of gas fixtures should test their output at the factories. Second. The periodical inspection of gas lighting fixtures and other gas appliances in hotels, lodging houses and tenement by the city authorities. Third. The prohibiting of the use of gas in all sleeping rooms of less than a stated number of cubic feet capacity. Fourth. The use of so-called automatic burners in the sleeping rooms of hotels and lodging houses. The term "automatic"

m this connection is intended to designate a gas burner from which gas cannot escape except when lighted. Several ingenious so-called "self-lighting" burners have been patented within a year or two and are now placed for sale. If a person should blow the gas out where these burners are used, the gas would become automatically lit and no asphyxiation can result. FIFTH. It has also been repeatedly suggested to restrict by law the amount of carbonic oxide in gas and to prohibit the distribution of any gas containing more than a stated quantity of this poisonous ingredient. In my judgment, it will be a difficult matter to enforce such a statute, and managers of gas companies may surely be expected to oppose any such measures, as in recent years they found it to their advantage to manufacture a carburetted water gas instead of the coal gas.

Under all circumstances diligent care should be exercised in the use of gas fixtures and gas fittings. This, together with an official supervision of the gas piping and with popular instructions disseminated by the gas companies to their customers, will accomplish much good in preventing fatal accidents in the future.

APPENDIX.

SUGGESTIONS FOR THE PROPER ARRANGEMENT OF GAS PIPING WORK.

GAS SERVICE. To be of wrought iron pipe, of ample size; to be run into building with pitch back to street main where possible; or else to be provided with siphon or drip pipe and emptying plug where service must necessarily be graded toward the house. Service pipe to be protected from frost wherever necessarily exposed.

GAS METER. To be preferably a dry gas meter; to be of ample size; all connections to be preferably of wrought iron pipe; fittings to be beaded malleable iron fittings; no lead meter connections to be used. Meter to be set in a cool, ventilated, well-lighted place, easy of access, but protected from accidental injury.

HOUSE GAS PIPING. To be of a good quality of wrought iron pipe, preferably galvanized. Steel pipe being somewhat brittle is not so good. Lead gas pipes should not be permitted. Cast iron pipe is only used for services larger than 2½ or 3 inches in diameter.

PIPE FITTINGS. To be of malleable iron, preferably beaded fittings. Fittings to be selected and examined for sandholes. Galvanized fittings to be preferred.

JOINTS. To be screw joints. Use red and white lead mixed, or boiled linseed oil in joints. Use precaution not to get lead on the inside of joints. No gas fitter's cement to be used on joints under any circumstances. The practice of rusting the pipes up by filling the gas

pipes up with water is bad and should be prohibited. Unions should be avoided; if required, use ground joint union fittings. No washer joints should be permitted. All joints must be made absolutely tight.

Shutoffs. Use best quality heavy brass work; round way ground key lever cocks are preferable to valves, as they indicate at once by position of lever whether the pipe line is open or shut. Valves, if used, should be soft-seat brass valves. Iron valves not to be permitted, as they quickly corrode from the action of the gas.

Hooks, Straps and Clips. All pipes to be well fastened by hooks, straps or clips of wrought iron, not of cast iron. Use screws for fastening, no nails or common hooks.

Cutting of Floor Joists. This should never be done by the gas-fitter; the carpenter to do all cutting, and beams should not be notched, bored or cut more than two inches in depth, and never further away from wall or bearing supporting the beams than two feet.

Sizes of House Pipes. No pipe to be less than three-eighths, better one-half inch. In determining sizes of pipes, follow the Table I for sizes of house pipes for gas lighting, and the Table II for sizes of gas pipes for gas ranges and gas logs. Make all piping ample in size.

Arrangement of Gas Piping. No risers to be placed on outside walls. No riser to be less than three-fourths inches. A number of separate risers is desirable; these should be connected at the top for a better circulation of the gas and to avoid undue variation in the gas pressure. Another method is to have separate risers for each floor. For gas logs in fireplaces run entirely separate risers, one for each vertical group of fireplaces. Provide a separate riser for the gas cooking range in the kitchen. A separate meter for gas used in cooking or heating is also desirable.

Larger risers to be kept exposed in closets, smaller pipes to be tested before being covered up or plastered over. Running lines in floors to be kept accessible by floor boards secured with brass screws instead of nails.

Run all branches for side lights up from below, and do not drop them from above (except in the cellar). Place no running gas lines under tiled floors or hearths. Supply drop lights from branches taken off from side or top of running lines, never drop the branch from the bottom of a line. All horizontal gas pipes to be run with sufficient fall back to the riser; the horizontal run at cellar ceiling to have a fall towards the gas meter. All long horizontal runs between floor beams to be well supported to avoid sagging and traps. Avoid all condensation of gas in pockets or depressions.

GAS OUTLETS. Place no gas outlet behind doors or too near window trims or curtains.

TEST OF GAS PIPING. The entire gas piping, when completed and before plastering is begun, to be tested by gas-fitter with air pump and mercury gauge (22 inches long); spring gauges are not reliable. Test the piping under a pressure equivalent to a column of mercury in gauge 18 inches high (9 pounds.) Mercury in gauge must stand one hour without indicating a greater fall than one-fourth inches per hour. All leaks and defects which the test reveals to be made good by gas-fitter. No split pipe or broken fitting, or fitting having sandholes to be repaired with cement or solder.

In large buildings test gas piping in sections. After the tests have a number of capped outlets opened slowly, on each of the floors, to make sure by the falling of the mercury in the gauge that the entire piping has been under the test, and that no parts are accidentally or intentionally disconnected. After test leave all outlets capped tightly. When alterations in the gas are made or additional lights are put in, test the altered work in same manner as in the first test. Before the gas fixtures are hung or put up, the gas fitter to repeat the test in the presence of the contractor for the gas fixtures, so as to demonstrate to him the tightness of the entire piping. This leaves the fixture man responsible for any leaks discovered when the gas is first turned on at fixtures. After fixtures are hung, apply another pressure test with three inches of mercury in gauge.

TABLE I.

Of Sizes of Gas Pipes, Maximum Lengths and Maximum Number of Burners.
(At 6 cubic feet each.)
(From Engineering Record.)

	Max. length.	Max. No. lights.
⅜ inch pipe	20	2
½ inch pipe	30	3
¾ inch pipe	40	6
1 inch pipe	60	10
1¼ inch pipe	70	15
1½ inch pipe	100	30
2 inch pipe	150	60

TABLE II.

Of Sizes of Gas Pipes for Gas Logs and Cooking Ranges.
(From Engineering Record.)

	Maximum Length.	Sufficient for
½ inch pipe	100 feet	1 cooking burner or one gas log.
¾ inch pipe	100 feet	2 cooking burners or 2 gas logs.
1 inch pipe	100 feet	Gas cooking stoves with 4 burners or 4 gas logs.
1¼ inch pipe	100 feet	Larger gas ranges or 7 gas logs.

Gas logs and burners of cooking ranges are assumed to have a consumption not exceeding 35 cubic feet per hour. For larger consumption increase the size of pipe supplying log or range.

LITERATURE.

See Gas Piping for Buildings, published by the Engineering Record, N. Y., Sept., 1894.

See Gerhard, Gas Lighting and Gas Fitting, 1893.

See Specifications and Rules for House Piping, issued by the United Gas Improvement Co., Phila. Gas Works, 1899.

See Public Statutes of Massachusetts relating to gas fitting, and revised regulations pertaining to gas fitting, 1898.

See Rules and Regulations of the Denver Consolidated Gas Co.

See Rules of the Fire Marshal of Pittsburgh for piping for Natural Gas.

SOME PREVENTIVE MEASURES TO DIMINISH THE NUMBER OF ABORTIONS AND STILL-BIRTHS.

By Dr. MANUEL GUTIERREZ,

Professor of Obstetrics in the National School of Medicine, Mexico.

Mr. President and Gentlemen—The subject which forms the title of the imperfect work I have the honor to present is, in my opinion, of great hygienic importance, because besides treating of a considerable diminution of the population of every country, it is what we may call an inexhaustible source of causes that are capable of bringing about that undesirable condition, and presents enormous difficulties with respect to the measures which we adopt for the purpose of avoiding or limiting the evil.

It would be very desirable to obtain uniformity of opinion as to what we are to consider abortions and still-births, and this necessity makes itself especially felt from a statistical point of view; because whilst in some tables the rules require the statement of the cause of death according as this depends on disease or accident during pregnancy or on reasons of dystocia; in other cases, and this is the practice followed by the present Chief of the Statistical Bureau in the Supreme Board of Health in Mexico, exclusive attention is given to the vitality or incapacity of living on the part of the product, calling it still-born in the first case and abortion in the second, which denomination is entirely adapted to the requirements of science and law.

But there is still another source of confusion and it arises from the fact that under some legislation, those deaths which take place before the official declaration of birth, are registered amongst the still-born; and this practice is not only entirely contrary to the method with which we have proposed to deal with this matter, but as a demographic factor takes a position that is entirely opposed to the former.

If, as is so justly observed by Bertillon, the abortions and still-births ought not to figure in the tables of mortality, because strictly speaking they do not increase it, there can be no doubt that they make an appreciable reduction in the number of births, and therefore of the population; a thing that we can never be indifferent to if be bear in mind that the prosperity of a community, from an anthropological point of view, is intimately connected with the excess of births over the deaths.

During a period of eight years, from 1891 to 1898, the City of Mexico has registered the abortions and still-births shown in the following figures:

Year	Abortions	Still-births
1891	351	584
1892	556	450
1893	514	409
1894	517	197
1895	802	207
1896	1103	132
1897	1016	131
1898	1112	156
Total	Abortions, 5971	Still-births, 2266

Great questions of public and private hygiene are intimately related to the genesis of fetal death, and each one of them certainly deserves a careful study, which is beyond the scope of a work of this nature; for which reason I will only call your attention to the most important points, without entering into any detail.

To begin with, we have to set apart all those cases in which the death of the product has been artificially caused from those in which it has supervened in an accidental manner.

Although whatever may be said, the cases that are included in the first category, are due to the pregnant woman, to the midwife or to the physician (a very rare thing in Mexico) the true and efficacious remedy is to be found in a strict and healthy morality and in a knowledge of professional dignity, whilst it is the duty of the law to support this teaching by establishing and promulgating the severest penalties for those who are responsible for such an inconceivable crime. In Mexico, where intentional abortion is a rare offense, and might be said to be absolutely unknown as produced by physicians, the penal code has nevertheless provided for the case and by imposing penalties that vary according to the circumstances, which do not interest us for the moment, from five years imprisonment to death, in every case deprives the criminal of all power to continue in the practice of the profession.

Between the intentional abortion and that which we may call involuntary, we can place that which may be styled medical and which the law sanctions under the condition that it is the only resource to save the life of the mother and is carried out after consultation with specialists in that branch. On this point, the code does nothing more than respond to the demand of science as the result of its investigations.

But the indications which demand the disoccupation of the matrix, which have been perhaps too abundant in former times and which are now properly limited, day by day become less necessary, if we bear in mind the progress realized in a better knowledge of the affections that

demand such operative methods, in the acquirement of safer resources, and above all in the well established conviction that in those difficult situations in practice it is not the fulness of the uterus, but the profound alteration of the system, the disorder caused by the presence of toxines in the blood that bring the mother to the doors of death. Of what use then are abortion and a forcible delivery?

For my part I can say, that during the 27 years that I have been practicing my profession I have not up to this date found any necessity of interrupting the course of pregnancy, except in very grave and desperate disease on the part of the woman, but always strictly with the object of saving the fetus.

If, therefore, after a careful study of everything relating to this part of obstetrics, which up to this date has been highly destructive, and which, like surgery, ought to every day become more and more conservative we conscientiously restrict the opportunities for feticide as counseled by hygiene, it is certain that many beings would live who are now condemned without appeal to a useless death.

The many opportunities or predisposition to accidental death of the embryo or fetus, lend themselves to different interpretations and are exposed to different hygienic counsels according to whether they are observed at a time previous to the conjugal relations, or when these have produced their result in conception.

Very difficult and at times impracticable is the office of hygiene in the first supposition, and it more especially refers to demonstrate in the impropriety and even responsibility that results from certain marriages, which ought to be prohibited, or at least restricted.

The diseases of the heart and of the kidneys are in the highest degree serious for the mother, and their seriousness is greatly increased during pregnancy, resulting in special opportunities for the premature expulsion and death of the product, when both would certainly improve by maternal celibacy.

One of the greatest plagues of humanity, syphilis, has an immense importance in the matter we now discuss, because although it may be cured, it sometimes remains so long in a latent condition and the duration of its transmissibility depends on so many circumstances that cannot be easily appreciated, that the ordinary rules for permitting a marriage under such conditions frequently fail, with a serious risk of domestic disaster. Where is the physician who has not been able to observe cases of fetal syphilis, caused by the mother or by both, in spite of the able and prolonged treatment to which the father has been subjected? We have here a question that ought always to be before us.

From the most ancient times, hygiene has found its principal assistant and even its mentor, in the religion that has considered consanguineous

marriages illegal and has placed insuperable obstacles to them for reasons that are not only known to the physician, but also to the laity, and the object of which is to preserve the health, constitution and life of the products of conception; and it is to be desired that the civil law should give a hearty support to the wise provisions of eclesiastical law. The very early age or the advanced age of the parties, in a similar manner have a great deal to do with the final results of gestation, and if we also consider that in one case the woman is entirely wanting in the moral qualities necessary to the character of wife and mother, and that in the other she will have no time to attend to the proper bringing up of the children, they can easily understand the impropriety of such marriages.

Nervous diseases, of which we may consider epilepsy the principal one, are not more favorable to the interest of the fetus, or less worthy of the attention of the hygienist and legislator. If in them the abortion and premature delivery are the result of the nervous and circulatory disorders which belong to that disease, we cannot give less importance to the mechanical ill-treatment which the genital organs receive during each fit.

The same disorders and dangers are presented by the morphine habit, for which the weaker sex appears to have a special predilection, and which, besides keeping the woman in a perpetual state of hyponutrition, and entirely unfitting her for the proper development of the embryo, finishes by converting her into an automaton, forgetful of herself and all her surroundings, irresponsible in all her acts and altogether forgetful of the desirability of interdiction.

In the meeting of the American Public Health Association which was held in Mexico, my respected and esteemed colleague, Dr. Licéaga, demonstrated the impropriety of marriage between tuberculous parties; and this thesis runs specially in line with the subject of my paper. As a matter of fact, however complicated may be the questions connected with tuberculosis, whether we treat of an innate or acquired predisposition, of contagion by atmospheric, digestive, genital or other channels, the truth is that that disease constitutes in many cases the prologue to abortion.

It is a great pity that the special difficulties that I have shown cover so many contrary interests, which always render it difficult to adopt the counsels and instructions of the physician. But that which really renders them useless is the little attention paid by the interested parties either through ignorance or deliberation. This does not prevent but on the contrary stimulates us more and more to insist on these points, until the powerful voice of duty is heard.

Some of the causes that I have studied may present themselves when pregnancy is already a fact, and then hygiene is required to fulfill a double duty; on the one side we must take all measures of a general character which are intended to obtain the prophylaxis or extinction of the morbous or other agents, which, amongst other effects, are capable of producing the suspension of pregnancy and in fact would be an excellent preventive of abortions and still-births. On the other hand, we must observe all those precepts which insure the product against anything that may attack its health and vitality, and permit the gestation to reach its proper termination.

Under this head we may classify tuberculosis and the morphine habit. With respect to the first, the strict hygiene of the tuberculous individual and of the atmosphere that surrounds them, should be of the most exact and even exaggerated character, in order to prevent that fatal enemy from attacking the fetus and its annexes.

With respect to morpho-mania, it appears that its adepts are in proportion to the gravity of its evils and disastrous effects. We all know the numberless evils that are brought on by this vice; not content with demonstrating them, physicians have almost entirely forbidden the use of injections of morphine, but nevertheless the diseased persons continue to use them. In my opinion the principal point and perhaps the whole difficulty consists in the illegitimate sale of the alkaloid with or without a medical prescription; because if the morpho-maniac could not count on this resource, which is not like alcohol, a thing that he may take or not at will, it is evident that do what he would, he could not develop his vicious habit. There are no words sufficiently powerful to show the urgent necessity of coercive measures against the evil I speak of.

I do not know up to what point the abuse of alcohol on the part of a pregnant woman may bring her to the same situations and produce the same results as in the case of morpho-mania. There would be nothing extraordinary in it if we reflect that dyspepsia, anemia, fatty degeneration of the liver and other organs, with all the functional disorders that come in their train, necessarily exercise a fatal influence on the product of conception, and that this and its annexes being fed with the same blood charged with the toxic agent, are exposed to the same alterations and therefore to the breaking of the ties which connect them with the mother. It is certainly very difficult, in treating of the subject of the hygiene of pregnancy, to separate the matters that pertain to obstetrics from those that pertain to hygiene, as they generally go side by side, or, rather, the former are simply one of the many applications of the latter; but still I will attempt to show some of those that are most important from a sanitary point of view.

We have a custom that is consecrated by fashion under the name of bridal tour, and that could not be more injurious. To oblige the newly married woman to execute what might be called forced marches, when she has just suffered a real wound, and when she has perhaps already conceived, but in an atmosphere of notable congestion or genital inflammation, and just when she most stands in need of repose, is to insure an abortion, and this is really the secret of many hemorrhages that are unduly attributed to the change of condition.

Besides, even after this period, journeys of whatever nature they may be are injurious, although their influence may not be so decisive, but they have more or less the same results and for the same reason as in the case above cited, and to this we may add the facility with which the placenta becomes previous in the pregnant women who travel much as shown by the observations of Prof. Pinard.

The reason of many premature births is also found in the abuse of the corset, which if merely worn for comfort, is in no way injurious, but when worn in that exaggerated style which is used by those who desire to show a small waist and a shape that does not belong to them, becomes an insuperable obstacle to maternity.

The autocrat of fashion which brings everything under his rule, has made bicycle riding on the part of woman not only an amusement, but a real necessity. Without entering into discussion of the impropriety of this exercise outside of the period of gestation, there can be no doubt that it constitutes a powerful oxytocic, as the movements that it brings into action, and which apparently only affect the lower limbs, have their real origin in the pelvis, where they give rise to congestions, inflammation and displacement of the organs inside, and as a corollary the separation of the ova. For these reasons I say that the bicycle should be left to the stronger sex, or only used by the weaker when not married.

For the same reasons, the same results are brought about by the use of the sewing machine, which is not demanded by fashion, but has become a vital necessity for the working classes, and in this case, too, hygiene can render great services to this class, and relieve the pregnant woman from the danger of abortion to which she is brought by her trade, demanding that this useful invention should be perfected by obtaining an automatic movement which will be produced by a simple and cheap mechanism.

I have been glad to note for some time past, a reaction in favor of the so-called English style shoes, which if imperiously demanded by women for the purposes of a comfortable walk, become a vital necessity in the course of pregnancy, when walking is difficult and the center of gravity of the body is progressively altered.

It was said with great justice by a professor, that very often what has been formed by man is also destroyed by himself, and, in fact, the abuse of sexual relations is, after syphilis, one of the most important factors in the pathogeny of habitual abortion.

Although great exaggeration has been made with regard to the observations of Brown-Sequard on the action of carbonic acid in contracting the matrix, there can be no doubt that an atmosphere which is passed through this gas and with carbon oxide, is bad for a pregnant woman, and therefore it is necessary that in those places where many female workers are employed, this evil should be avoided by an adequate supply and perfect renovation of the air which they breathe. The deprivation of sunlight often brings about the same results.

I do not think I have anything else to point out unless it is the medical and therapeutic precautions to which a woman ought to be subjected when she carries in her womb the fruit of conception; but even in this case I think if by means of a popular distribution of printed instructions that would be intelligible to all classes and that would in a very simple manner explain all these precepts in detail, we could make a great advance in the desired sense of prophylactic measures.

Besides the special data that should be explained in these cards or pamphlets, and which I now have no time to enter into, I think they ought to insist on three principal points: The necessity of a timely inspection of the pregnant woman by a physician who could prevent the existence of many cases of dystocia; the frequent analysis of the urine, prophylaxis of the albuminaria and eclampsia; the conviction that by these means and others within the reach of the physician due protection will be given to the health and life of the child, although the mother may have suffered one or more abortions in passed times.

You will see that I did not go out of my way in asserting the importance of the subject which I now bring before this Congress, and as it is at the same time an entirely virgin subject, because with the exception of the paper I had the honor to present in Denver in the year 1895, nothing more has been done on the subject I now formally propose to the American Public Health Association that it appoint a committee to study the subject of the "Prevention of Abortions and Still-Births," which will present a yearly report of its labors.

By way of summary of the points I have treated of I would state my belief that hygiene can contribute to the diminution of the number of abortions and still-births by the following means.

1. By demanding of the Legislature the enactment of severe laws against intentional abortion, especially when carried out by scientific persons.

2. By demanding the most limited restrictions of medical abortions.

3. By pointing out the evils and responsibility which result from marriages between blood-relations, between very young or very old persons, between those suffering from cardiac or nephritic diseases, morpho-maniacs, epileptics, consumptives and syphilitics.

4. The taking of general measures against tuberculosis and other diseases that are capable of injuring the product of conception.

5. By overlooking and severely punishing the illegal sale of morphine and other substances that are injurious to the health of the maternal fetus.

6. By warning against the bridal trips, bicycle riding, abuses of the corset and of sexual communication, as well as the use of badly made shoes during pregnancy.

7. By giving the sewing machine an automatic movement which would not injure a person working it.

8. By requiring an adequate supply and renewal of air in those places where a large number of women work for any length of time.

9. By a proper instruction in all the treatment and methods that should be employed for the purpose of obtaining a natural delivery at the proper time.

The whole of these proposals could be properly treated and regulated by means of a committee of this Association which I now have the honor to address.

NOTES ON THE FREQUENCY OF CERTAIN DISEASES THROUGH DEFECTS IN OXIDATION AT HIGH ALTITUDE.

By Dr. JUAN CAMPOS, Toluca, Mexico.

The pathological conditions originated by disorders in the process of nutrition are multiple and varied, forming a particular group denominated "Diseases of Nutrition." Many of these, up to the present time, we have not been able to localize anatomically. The physiological experiments give only presumptions, although very well founded, in respect to the anatomical location in some cases, but do not reveal an efficient cause of the disease. The estatic alteration producing the functional disturbance is entirely unknown to us. Clinical observation shows us a general condition, more or less serious. An organism intoxicated by poisons elaborated by itself normal products of cellular elaboration, but formed in excess, or bodies of incomplete oxidation, which have not arrived at their last transformation to be definitely excreted. The diseases, or auto-intoxications, constituted in this manner, form a group *sui generis* essentially different from those originated by exogenic poisons, distinct also from some others, which although produced by poisons formed in the body of man, like those which arise in the mucous cavities, principally in those of the digestive apparatus, but not existing in the interior of the cells, should be considered as coming from without. By this short explanation it will be understood that I refer to artritismo. The affections which constitute this group, manifest, some of them, themselves in the same individual all at the same time, or occur one after the other. They are transmitted by heredity, being either heterologenous or homologenous. They are associated very frequently with the different neuropathic states, presenting a group of symptoms most confused and varied, making it extraordinarily difficult to form an exact diagnosis, and the rational and scientific treatment. The doubts of the physician charged with the treatment of patients of this class are to be explained, if it is taken into consideration, that we know little or nothing of the pathology. The alteration, functional or dynamic, precedes or follows the structural lesions. The etiology is obscure, in many cases we know the predisposing causes, those which occasion, but not those that are at work. Frequently in the course of these diseases secondary intoxications develop, producing reactions so varied, that it is difficult to follow this long succession of disorders, and keep track of the true

origin of the disease. It is not my intent to describe these diseases, or even enumerate them all, it would be out of place, and inopportune; inasmuch as they are already sufficiently known to the illustrious body of professors in medical science, before whom I have the honor to present myself, and by whose favor I now have the floor. I will permit myself solely to designate them as morbid entities, very frequently encountered in high altitudes. If I may judge from the observations of twenty-six years of constant practice of my profession in the city of Toluca, Mexico, I will show briefly the principle morbid entities which show themselves there, most frequently in relation to artritismo. I will submit to the consideration of the congress, the treatment which I have seen give the best results in my practice; finally I venture to propose the means, which, according to my humble judgment, should prevent, or at least render these troubles less frequent, this being truly the objective point of my work, desiring with my grain of sand to assist in diminishing, as much as possible, the diseases of afflicting mankind. In Toluca, at 2625 meters above sea level, mien annual temperature of 15° centigrade, dominating winds southwest, 550 mm. mien barometric pressure, and with 25,000 inhabitants, it is a common thing in the practice of my profession to find patients with a low vital force, presenting a group of symptoms which cannot be explained by physical examination, notwithstanding a most minute investigation, no organic lesion is discovered. If in cases of this class analysis of the urine is made, almost invariably a satisfactory explanation of the pathological condition is discovered, now it will be a quantity of glucose, now of albumin or perhaps uric acid, urea, or the phosphates in exaggerated quantities, in respect to the quantities that should be excreted normally. Outside of such cases, treating of individuals afflicted with diseases whose diagnosis may be easy or possible, as rheumatism, neuralgia, dyspepsia, cardiac lesions, etc., if in these cases we proceed to an examination of the urine, we certainly find more or less alteration, this is easily understood, because the organic functions, not being physiologic, the urine which is the vehicle of the greater part of the products of secretion destined to expulsion, should be modified in the relation of its normal components. Considering the frequency with which the physician finds no more explanation which he has to face, than the modification of the urine, it is not to be thought strange that in high altitudes certain diseases are frequently found, such as glycosuria, albuminuria, uremia, or azoturia.

In the past three years Sr. Enrique Iglesias, professor in pharmacy, has analyzed over four hundred specimens of urine, and in almost all has found a deviation from the normal. Rheumatism in all its forms, dyspepsia, biliary lithiasis, organic lesions of the heart, in their differ-

ent localizations, hysteria, in all its forms, and in general the very varied number of diseases which refer to artritismo, are very common in the city of Toluca. To what attributable, the full and easy development of the diseases of nutrition in high altitudes? The solution is more difficult than would seem at first sight, particularly when consulting that which has been written on the subject, we encounter divers opinions, some of which are in conflict with the most elementary notions of physiology.

My worthy and respected fellow countrymen, Prof. Herrera and Vergara Lope, in their magnificent work entitled "La Vida en las Altas Mesetas" (a work awarded a premium by the Smithsonian Institute, Washington), refute the theories of Dr. Jourdanet on the barometric oxyhemia, showing with irreproachable physiological experiments, with numerous statistic data, that the quantity of oxygen absorbed in a given time is the same in high altitudes as in the low, that the animal temperature is also equal, in a word the phenomena "Nutrition" are exercised in a more physiological manner with the indispensable modifications related by the barometric diminution. The before mentioned gentlemen conclude that the blood of the inhabitants of high altitudes is denser on account of the strong evaporation of water, which takes place in the lung surface during the respiratory act, that it is richer in red globules and in fixed substances; the urine is also denser, less abundant, and contains a larger proportion of urea. We have here a theory for the doctors who practice in high altitudes.

From the statements of Srs. Herrera and Lope it may deduce that the altitudes have no favorable influence on the development of the diseases originated by vice or the disturbance of the nutrition, that they should not be more common in those regions. I have not practiced in low altitudes and have no personal means of comparison, but from what my practice has shown me, I judge that the aforementioned diseases, without being peculiar to high altitudes, certainly are more frequent than in low.

I shall briefly explain the reason for this belief. The normal temperature in a majority of the inhabitants of Toluca is not 37° C., but is usually 36° to 36½°, a phenomenon proven by my fellow practitioners in that locality. I myself, after active muscular exercise during the day, have had not more than 35½° C. in the axila, this in a good condition of health, and ratified by the use of different thermometers. It grieves me to differ, in this respect, from the statements of Srs. Herrera and Lope, but the fact is certain and of much account in the subject under discussion.

Analysis of urine of individuals, who apparently enjoy perfect health, conscientiously made by Mr. Iglesias, have demonstrated a multitude

of times the existence of glucose or albumin, or both, without our being able to say that any disease existed, as all the functions worked in perfect order, and the general condition of the individual revealed no disturbance of nutrition. The phenomena of organic oxidation do not always reach their end with impunity. I have shown before, the frequency with which we find patients suffering from artritismo.

I am sorry not to present numerical data in proof, but I do not doubt that many of my respected brother practitioners here present, who exercise their profession in high altitudes, have made the same observations.

As before said I believe we may infer that the phenomena of oxidation, which occur in the organism in the intima of the cells, which normally at last should produce carbonic acid by the combustion of the starches and fats, and urea with its derivitives, by the combustion of albuminoids, is frequently incomplete in high altitudes, notwithstanding that the oxygen which in a fixed time is absorbed in respiration, may exist in normal quantities, as has been fully demonstrated by Srs. Herrera and Lope. Clinical observation and chemical analysis cannot be more eloquent. How may we explain in other ways the low physiological temperature, the frequency of glycosuria, the excess of uric acid, etc., without admitting defective combustion, either glycogenic or azoados, or both?

It is shown particularly by the increased density of the blood in high altitudes, by diminution of the quantity of water, owing to pulmonary evaporation, the urine less abundant, and also more dense. Is it owing to the richness in fixed elements, to active nutrition, the perfect and rapid changes of assimilation and disassimilation? I do not believe it, but on the contrary, I think that in the blood, products of incomplete combustion accumulate, glycose and the numerous group of urides giving rise to the multiple manifestations of artritismo.

The therapeutic treatment should tend in general to two chief indications: To render more active the organic combustion, and to facilitate the elimination of its divers products, filling moreover all the symptomatic requirements of the morbid manifestation. If two of the most common, glycosuria and albuminuria, are presented before me, I do not hesitate to recommend the combined use of strychnine and pilocarpine, in the following manner: I prescribe 1 miligramo of sulphate of strychnine, three times a day, or a pill three times a day of 10 centigramos of benzoato of cafeine and sodium, and 2½ miligramos of iodide of strychnine and zinc, and at the same time I order my cases 60 drops divided in three doses, of a solution of 10 grams of distilled water and 5 centigramos of chloride of pilocarpine, representing 1½ centi-

gramos of active substance in 24 hours, increasing or diminishing the dose according to the tolerance of the individual.

I combine with this treatment a rigid dietetic regimen in appropriate cases. The results which I have obtained in my practice could not be more satisfactory. I have always achieved a notable improvement in my patients, and in some have seen a complete cure. Not wishing to vary from the statistical truth, I will only mention 56 cases in which the analysis was quantitative, either for glycosuria or for albuminuria, adverting to the fact that the statistics would be most ample, if we take into consideration the other analyses, which were only qualitative. With your permission I will refer to some cases in my practice, the persons still living, taken from my registry of urinary analysis:

CASE 1. Sr. Lic. H., 46 to 48 years of age, fair constitution, was afflicted some ten years past in consequence of veneral excesses and disorders of other natures, with a general grave condition. His physical force he lost notably and progressively, to the extent that when he solicited my professional care he was not able to stand. The loss of flesh was well marked, for the rest, the functions all worked regularly. An examination of the principal organs gave no explanation of this pathological condition. On analysis of the urine a large quantity of glucose was found, this important discovery determined me to subject my patient to the treatment before mentioned, which being scrupulously carried out, gave the best results, the glucose diminished, the general health improved, and everything worked in order at the end of six weeks or two months. At present he enjoys fair health with the exception of occasional neuralgic attacks, he has had no serious illness, and his urine in subsequent analyses has not given the slightest indication of glucose.

CASE 2. Mrs. M. M., aged 60, good constitution; was affected with pleuro-pneumonia, terminating by resolution on the seventh day; convalescence was not frank. She suffered from dryness of the mouth, polydipsia, polyuria, and weakness. Analysis of the urine showed the existence of glucose, which disappeared in a few days under the same treatment. The glycosuria was followed by acute articular rheumatism, which was combatted successfully by the proper treatment for this disease, bringing about an immediate relief.

CASE 3. Lic. T., aged 54, nervous lymphatic temperament, obese, weight 212 lbs., afflicted for some years, almost periodically, with attacks of gastric saburre, accompanied by disturbances of the nervous system purely hysterical, sometimes with a profound depression, sometimes with an exaggerated excitation with partial convulsions, tonic or clonic, notable loss of strength, absolute anorexia, tongue badly coated, regurgitations of gastric fluid mixed with bile, constipation,

meteorism, intestinal paresia, dominated solely by means of purges. In this condition he remained for a time varying from 15 to 30 days or more, and after an insomnia prolonged throughout an entire night he would rapidly recover, his appetite and strength would return and all go well. An examination of the principal organs revealed no structural lesions, except that the liver was found a little reduced. His urine had always been dense, rich in uric acid and urates, in quantity from 1000 to 1500 grams a day. On August 14th present year, he informed me that his urine had increased considerable in quantity, being in 24 hours about 5 litros, his thirst was excessive, appetite notable; in a word he presented a complete picture of a case of "diabetes millitus," polydypsia, polyphaga, and polyria. Subjecting the urine to an analysis the enormous quantity of 80 grams of glucose to the thousand was revealed. He submitted himself immediately and rigorously to treatment of strychnine and pilocarpine. The 22d of the same month, or eight days after beginning the curative treatment, an analysis of the urine showed 28½ grams to the 1000. On the 25th he had a return of gastric trouble with all the cortege of symptoms before stated. The 28th, an analysis of the urine revealed not the slightest vestige of glucose, the thirst disappeared, and the urine diminished to 1500 grams, the gastric saburre lasted until the 23d of September, ending as usual with insomnia throughout the entire night.

I have since examined the urine and it presents traces of glucose. In the time intervening from one attack of the gastric saburre to another, the patient presented no symptoms worthy of attention, except some rheumatic pains in the small articulations.

CASE 4. Mr. M. A., aged 68 to 70, good constitution, complained of thirst and exaggerated hunger. Examining the urine on August 22, 1898, there was found 20 grams to the 1000 of glucose, and the corresponding treatment was prescribed for him at once. On September 5th an analysis revealed 19.18. Subsequent examinations made up to date give as an average quantity 0.75. The health of the patient is good.

CASE 5. Mr. T. G., with cardiac lesions, and previous attacks of articular rheumatism. February 28, 1898, his urine showed 28.57 of glucose. He was given treatment at once. March 11th it had decreased to 10. On the 27th of the same month, 6.66. April 14th, 4.44. April 27th, 10, (the patient had not strictly observed the treatment). May 16th, 4. Analyses have been made up to the present time, urine now showing 0.83. I could continue quoting the quantitative analyses of urine of glycosuric and albuminuric patients to the number of fifty-six, but it would make this work too long and tiresome. I have but to state, that in all the cases under the influence of the same

treatment the results have been satisfactory. The disease has, in many persons, diminished in more or less time to a degree where it causes no anxiety. In others it has disappeared altogether, without returning, notwithstanding complete suspension of treatment and return to accustomed diet.

How may we explain so brilliant results, obtained with strychnine and pilocarpine? No great amount of reasoning is necessary to account for it. It is enough to know that strychnine works as a modifier of the nervous system revivifying, powerfully the functions of the organism, acting especially on the oxidations. Pilocarpine assists, as is well known, the secretion of the perspiration of this great purifier of the economy, sometimes it increases the secretion of the urine, but this is not frequent, as in the cases of glycosuria or albuminuria, with polyuria, far from noting an increase, I have seen this secretion decrease to normal.

By these simple means, I have been able to bring about activity in the organic combustion, and an easy elimination of products, which accumulated in the blood, originate morbid conditions. The other forms of artritismo, susceptible to the treatment by the same means, do not present the importance of those of which I have spoken, as fortunately the physician has at his disposition multiple recourses with which a cure is generally effected. The hygiene of artritismo, in my opinion, is formulated as follows:

First. Recommend a mixed diet, but moderate, in which the hydrocarbonates preponderate, especially feculents.

Second. Daily physical exercise in the open air.

Third. Avoid use of alcoholic drinks.

Fourth. Assist the functions of the skin, stimulating the secretions of the sweat.

It is undoubted that to comply with the necessities of the human organism, a complete alimentation is indispensable; that is to say, containing plastic and respiratory food. This is taught in the most elemental physiology. A diet to be complete should contain 18 to 20 grams of nitrogen and 300 of carbon, but this is an exaggerated food.

Thousands of men who work, consume much less; 12 grams of nitrogen and 265 of carbon is a mixed food, but moderate. The relation of carbonic acid exhaled, to the oxygen absorbed. is called the respiratory quotient, variable according to the nature of the diet, augments and tends to the unity with the hydrocarbonates, rich in oxygen like the starches, then all the oxygen absorbed in the respiratory act combines with the carbon to form carbonic acid, and that of the food combines with the hydrogen forming water. We have here a complete combustion; therefore the starches should preponderate.

A daily observation of the manner in which our Indians feed is most instructive in this respect. The food of the Indians is composed of "tortillas" (corn cakes), rich in starch and nitrogen, chloride of sodium in fair quantity, which is known as a good oxidizing agent, red pepper, a strong stimulant, occasionally cheese, and rarely meat. On this alimentary regimen our Indians live well, stand severe fatigue, and it is rare that we find among them glycosuria, albuminuria, gout, etc., and frequently living to an advanced age. On the other hand we have to observe that Herrera and Lope have demonstrated that in high altitudes the blood is thicker and richer, in fixed bodies, this density being due to loss of water by pulmonary evaporation. Accepting this fact as a scientific truth, proven by physiological experiments, we seek at once some manner of preventing this undesirable condition. Without doubt hydrocarbonated alimentation, starches in particular, tend to this end, for as I have demonstrated before, by this means the oxidations are facilitated, quantity of water increased, and the accumulation in the blood, of products of incomplete combustion, particularly the ureides, are avoided.

DAILY PHYSICAL EXERCISE IN THE OPEN AIR.

To demonstrate the necessity of following this advice, I take the liberty of translating literally the following paragraph, page 365, of P. Langlois and H. de Verigny's "Elements of Physiology":

"Pulmonary ventilation, influence null. The tissues produce no more carbonic acid than oxygen that passes through the lungs. They do not consume for pleasure, the more work the more carbonic acid they produce; respiration does not rule the combustion, the combustion rules the respiration, and it is not that the respirations are more rapid or deeper, that the tissues produce more carbonic acid from the moment they receive the quantity of oxygen which suffices for their actual necessities, but when the tissues in activity need a greater quantity of oxygen, the respiration is excelerated. In a word the tissues are not hungry for oxygen, and do not produce carbonic acid except in proportion to their activity. In repose they do not consume, except what they exactly lack, for they do not eat without hunger. To imagine the augmentation of the production of carbonic acid excelerating the respiration, is to put the 'cart before the horse'; this production is not increased except when actuated by the consumption of oxygen by the tissues, the increase of consumption excelerates the respiration; that is to say, that the ventilation remains parallel to the changes, and is arranged according to them."

On page 366 of the same work, we read the following: "The violent exercise increasing the respiratory quotient, which tends to the

unity, is that which consumes much glycogen in the muscles. If we consider that the muscles are, of all the tissues, those whose respiration is most active, even in repose, it is not surprising that any variation of activity operates forcibly on the production of carbonic acid."

From the preceding we may infer that the muscular exercise increasing the combustions raises the animal heat, and as you will remember, I have called attention to the frequency with which, in high altitudes, a marked lowering of the normal temperature is noted; exercise therefore should be recommended to prevent this condition. Alcohol has generally been considered as a powerful stimulant, actually it forces rapidly, excitation of the nervous system, but after this effect, is a depressor of the temperature, for we know that once absorbed it is burned up in the organism before elimination, in the form of water and carbonic acid, and this combustion cannot take place, except at the expense of the oxygen, destined to the oxidation of the tissues. So it is, that alcohol impedes or diminishes the production of animal heat, assisting the accumulation in the blood, of products incompletely oxidized. To facilitate the functions of the skin, render more action to the secretion of the sweat glands, we do not need, in my opinion, reasons which show, not only the utility, but the necessity of watching and keeping in motion this most important function of the economy.

In translating the foregoing it has been almost impossible to give in English the full and free translation that is desired. If, therefore, there should be anything that is not perfectly clear, it may be attributed to faulty translation, and not a fault of the author.

THE PREVENTION OF BLINDNESS BY THE ADOPTION OF LAWS COMPELLING HYGIENIC PRECAUTIONS.

By WALTER B. JOHNSON, M. D., Paterson, N. J.

The subject is particularly adapted to the consideration of the American Public Health Association in consequence of the intimate relation which it bears to the ordinary duties which are daily performed by the officers of the various State and municipal Boards of Health.

Blindness or impaired ocular functions occurring as the result of infectious and contagious diseases, unsanitary or other conditions, present etiological factors which could be considered amenable to relief or cure as a result of laws compelling hygienic precautions, and the causes may be classified in part as follows:

(1) Ophthalmia neo natorum,
(2) Purulent ophthalmia (gonorrhœal).
(3) Trachoma,
(4) Contagious and infectious diseases,
(5) Traumatism and poisoning,
(6) Refractive errors.

If it be assumed, as the statistics would seem to indicate, that from thirty to forty per cent. of the blindness occurring as a result of the diseases here enumerated, is avoidable under laws making compulsory hygienic conditions favorable to the prevention of these diseases. The necessity for the enactment and operation of such laws as will place this class of diseases under the complete and immediate supervision of health boards is apparent.

The beneficial effect of the laws at present in operation has been so generally admitted that legislators are favorably inclined towards the enactment of any law, for the prevention of blindness, which can be demonstrated to be calculated to result in benefit to the general public. Laws enacted for the relief of the hygienic conditions, which have been shown to foster impairment of the vision, have been received with equal favor, they have undoubtedly been of great benefit to the rising generation and will be of still greater service to the generations to come.

Ophthalmia, Neo Natorum; laws have been passed in many States of the Union to regulate the care and treatment of patients suffering from ophthalmia of the new born. In 1895 an act known as Senate No. 91 was introduced by the Honorable Robert Williams of Paterson, New Jersey, entitled "An Act for the prevention of blindness in the

State of New Jersey." It became a law and is now known as Chapter 118, Laws 1895, State of New Jersey, and reads as follows:

"1. Be it enacted by the Senate and General Assembly of the State of New Jersey, That should one or both eyes of an infant become inflamed, swollen or reddened, or show any unnatural discharge at any time within two weeks after its birth, and no legally-qualified practitioner of medicine be in attendance upon the infant at the time, it shall be the duty of the midwife, nurse, attendant or relative having charge of such infant to report the fact in writing, within six hours, to the local board of health of the city, township or other municipality in which the parents of the infant reside.

"2. And be it enacted, That the said local board of health shall direct the parents or person having charge of such infant suffering from such inflammation, swelling, redness or unnatural discharge of the eyes to immediately place it in charge of a legally-qualified practitioner of medicine, or in charge of the physician of the city, township or other municipality if unable to pay for medical services.

"3. And be it enacted, That every local board of health in the State of New Jersey shall furnish a copy of this act to every legally-qualified practitioner of medicine, and to each person who is known to act as a midwife or nurse, in the city, township or other municipality for which such board of health is appointed; and the secretary of state shall cause a sufficient number of copies of this act to be printed, and to supply the same to such officers for distribution.

"4. And be it enacted, That any failure to comply with the provisions of this act shall be punished by a fine not to exceed two hundred dollars, or imprisonment not to exceed six months, or both, upon conviction under prosecution proceedings to be brought by any local board of health.

"5. And be it enacted, That this act shall take effect and be in force on the first day of May, one thousand eight hundred and ninety-five."

In framing the law, which was drawn upon the same lines as those previously enacted by other States, an effort was made to overcome certain faults which had prevented the satisfactory operation of all of the similar laws. It seemingly provided for jurisdiction by local boards of health, made compulsory the immediate treatment of all cases by legally-qualified practitioners of medicine, provided for the distribution of copies of the law to every physician, nurse or midwife in the State, and apparently fixed a penalty and placed the prosecution proceedings in charge of the local boards of health. The law in the State of New Jersey, regardless of its apparent completeness, has been and is inoperative. Cases have not been reported to boards of health, for the reason that knowledge of the law's requirements did not reach

the persons in charge of those affected. The health boards did not send copies to the physicians, nurses or midwives, as no provision was made for the expense of printing and postage. The only approach to a notification was through a circular published by the State Board of Health in its annual report which naturally only reached a small number of the persons interested. The inference is, therefore, that the laws enacted to prevent the disease Ophthalmia Neo Natorum are inadequate, and supplementary clauses should be added, placing the disease upon the board of health's list of contagious and infectious diseases, making compulsory a report of all cases, whether under the care of a legally-qualified practitioner of medicine or not. Under such conditions the health board would be compelled to supervise the care of this disease in the same manner as the diseases at present upon the regular list are supervised. The officers of the board would either see that the provisions of the law were enforced, or, having the necessary organization and means to carry on a prosecution in any case of non-compliance with the law, they would speedily obtain a series of convictions under the law, which would certainly result in preventing its continued violation.

Purulent ophthalmia; although it occurs comparatively infrequently, is in the cases infected very apt to result in the loss of one or both eyes. It is the result of the direct inoculation of the conjunctiva by a specific virus carried either by the fingers, or infection through towels, wash basins, soiled rags or clothing. Only through the dissemination of the knowledge of the dangers of infection from the sources enumerated can boards of health do anything to prevent the spread of infection, unless the time should arrive for the enactment of laws compelling a general supervision of all of the homes of the demi-monde, which at present exist as necessary evils. Without supervision they are hotbeds for the germination of the bacterial elements which are the prime factors in the production of the disease from which infection of the conjunctiva occurs.

Trachoma and other communicable eye diseases; for the purpose of decreasing the frequent occurrence of the spread of diseases of this class, in almshouses, orphan asylums, homes, and other similar public institutions, it is desirable that the hygienic control and supervision of all of the buildings should be vested in the health board.

In 1881 Dr. C. R. Agnew, in his notes on contagious diseases of the eye in schools and asylums, suggested the practicability of the prevention of blindness in this class of cases by legal enactment in the following words:

"Diseases of the conjunctiva and of the cornea are largely the cause of prevailing blindness, and yet they belong in a great degree to the

class of preventable diseases. The fact that they do fall into this class gives to the sanitarian and to the legislator a special opportunity and advantage for inquiry, advice and legal enactment, to limit or prevent their prevalence."

With the advent of the specially appointed school inspector, or more properly medical supervisor, who should, although an independent officer, be in accord, and work in harmony with the health board. Each being of service to the other in carrying on in the public schools the laws for the prevention of blindness as a result of trachoma and all blenorrhœal communicable eye diseases, which may be carried by direct inoculation of the ocular or palpebral conjunctiva by the germs of the disease. Epidemic disease should be generally prevented if not eventually eradicated by the adoption of laws and ordinances by legislative bodies, and the boards of education, health and sanitation which have officers fully equipped to enforce the proper observance and execution of the laws.

Where laws do not at present exist ordinances should be enacted prescribing regulations compelling in all public lavatories, whether located in hotels or other places, a strict observance of necessary sanitary precautions, scientific plumbing, epecial care regarding the linen, and entirely forbidding the use of that common carrier, the roller towel.

In all schools and reformatories, applicants for admission should be examined by a competent medical examiner before admission, and any applicant declined who has any form of communicable eye disease, unless especial quarters are provided for the isloation of such cases.

The buildings of all such institutions should be periodcally inspected by experts in sanitary science and a detailed report made to the State or local health boards, setting forth the sanitary condition of the buildings, closets and lavatories. The capacity of the institution should be regulated by ordinance fixing the number of persons to be admitted, allowing an ample air space for each person, and providing for the entrance of fresh air and abundant sunlight. There is no source of danger promoting contagion more surely and rapidly than the massing together of humanity in the vitiated air of closely packed apartments with insufficient accommodations for proper ablution, and subtle poison arising from unsanitary sinks, lavatories and closets. The conditions referred to, by insidiously undermining the constitutions of the inmates renders them not only more susceptible to the contagion of communicable eye diseases, but makes them fertile fields for the germination of the bacterial products of any form of contagion.

There should be apartments especially light and airy set apart for the isolation of any case of communicable eye disease which may originate

within the building or may for any reason be admitted. The patients must be so domiciled that they will not become vehicles of contagion to the remaining occupants of the institution, and constant quarantine maintained until the danger of contagion has passed.

Contagious and Infectious Diseases. The diseases under this head are mainly at present under the direct control of boards of health and much good has been accomplished in lessening the number of the blind by the decrease in the number of cases of contagious disease, as a result of quarantine, isolation and general supervision. These results are especially noted in the corneal disease occurring in smallpox cases which so frequently resulted in loss of sight. The almost total suppression of this disease in consequence of compulsory vaccination laws and the passage of laws and ordinances for the supervision of this class of diseases has been of great service, and further good must be accomplished as a result of new laws and the increasing care and attention which boards of health are giving to the prevention of these diseases.

Accidents and Poisoning. Blindness as a result of accidents in factories seems to be on the increase. Greater precaution in guarding dangerous machinery should be compelled by law, and also the posting of notices in every place where danger exists. Workmen of age and experience should only be permitted to perform hazardous work. Employers should encourage the wearing of neutral glasses for protection. Systematic inspection and supervision of all workshops and machinery by competent officers should be compulsory. The question of the legal responsibility of employers failing to meet the standard requirements of the laws for the protection of their employes should be definitely settled. To preserve the eyesight of employes and assure the highest grade of work, employers should encourage the use of glasses which are necessary for the correction of refractive errors.

Thorough instruction in the chemistry of poisonous substances used in the arts should be given employes, and a knowledge of the best methods to prevent systematic infection should be necessary before they are permitted to commence work.

Refractive Errors. The conditions which have been important factors in the production of errors of refraction in school children have been, during recent years, changed so materially and the public sentiment has, through education, been so thoroughly aroused to the necessity of proper hygienic surroundings, and improved school methods, that a material decrease in the number and extent of the refractive errors has been the result. Municipal boards and the educators have in many instances accepted and acted upon the suggestions of the

medical profession and sanitarians with the result, that in the cities where the changes are fully carried out, the stage of perfection in heating, ventilation, sanitation, furnishing, and the general condition of the new school building leave apparently nothing to be desired. It would seem that the student might perform the maximum amount of school work under these very desirable conditions without the risk of ocular or physical injury. The educator has, perhaps unfortunately, observing that the conditions were rendered so very satisfactory for the performance of school work, constantly advanced the educational standard by altering the grades, extending the school curriculum and increasing the work necessary to meet the requirements to such an extent that it would seem to require more than a reasonable mental effort and attainment to perform the work. It would seem that the time has arrived when a careful consideration of the question,—"How much mental work should a growing child perform daily?" is of paramount importance.

The plan of school work must be so arranged that an ordinary individual possessing average intelligence should be able, by the employment of due dilligence, to perform the required amount of study without ocular of physical injury. Teaching should be didactic in character, with the aid of blackboards, maps, etc., to encourage frequent rest for the ocular muscles by the employment of the eye in distant vision. School study-periods should be arranged, and the amount of home work curtailed as much as a reasonable educational progress will permit. The fact that work at the near point is required at home, where the conditions are frequently quite as unsatisfactory as in any school, must not be lost sight of in arranging the course of study and allotting the time to be required for work outside of school hours.

Scientific advances will before long necessitate the assignment of scholars who have ocular or physical defects to a privileged class, where by a system of selective studies they may acquire a knowledge commensurate with their educational qualifications, and be given only the amount of school-work which they have ocular and physical ability to perform. Pupils with defective vision, or those who are physically weak, should not be advanced to their own detriment and to the detriment of the physically strong, nor allowed to undertake the entire school curriculum as now laid down for all students alike regardless of any consideration of their innate strength being sufficient to withstand the strain, or the possible result of a constant over-taxation of the physical and mental forces.

Unless measures are immediately adopted which will make the desirable changes in the increasing extent of the school curriculum, the educator will nullify every benefit which has been gained by all of the

hygienic and sanitary measures adopted. Attention is not called to this fact with any intention of underrating the value of higher education, for it is firmly believed and freely admitted that the advance in science, art, literature and commerce which the United States of America has made in a short period of time is unprecedented in the previous history of any national progress. It has been due, to a great extent, to the exceptional educational facilities, which have resulted in a general enlightenment of the masses of the people. The educational standard has been advanced to a plane necessitating so high a grade of general attainment that it entails for the ordinary scholar, except under favorable conditions, the expenditure of an amount of physical and mental energy greatly in excess of the average resources of the youth of the present age. The advantages gained must not be lost; the scholar must not be forced to perform sufficient mental work to impair his ocular functions or injure his physical condition.

The methods which have been adopted as the result of the enactment of laws which have made compulsory hygienic precautions, have resulted in a diminution of the number of the blind. This has been demonstrated by the decrease in the number of the blind shown in the census returns compiled during the past forty or fifty years, in the United States and in other countries. The enactment of laws which are inoperative is of no public service. The tendency to ineffective laws of this class is shown in the laws enacted which provide for supervision without providing for supervisors. The enactment of any measures for the prevention of the spread of disease will not be effective unless they specifically provide for report to and supervision of all cases of either contagious or infectious diseases by the Board of Health, or some specially appointed competent supervisor or inspector. The danger of conflict and disagreement between the control boards of institutions and the health boards or inspectors might be easily overcome, if the duties of each are strictly confined to their respective departments. Each board could be of assistance to the other and their public service greatly enhanced in value. Supervision in the hygienic department by specially qualified officers is an absolute necessity, and if such officers are not in full charge, regardless of the board or body of directors who are in immediate control of the buildings in use and their inhabitants, laws which are enacted for the prevention of the spread of disease must either result in failure, and be absolutely inoperative, or at the best be spasmodic in their action and effect.

REMARKS ON THE DAIRIES IN THE CAPITAL OF THE MEXICAN REPUBLIC—THEIR CONDITION BEFORE THE ISSUE OF THE SANITARY CODE—THEIR PRESENT CONDITION.

By Prof. JOSÉ L. GOMEZ, of Mexico, D. F.

Before the issue of the Sanitary Code for the Federal District and Territories, the dairies in the capital were under no hygienic inspection which would govern their organization and show the methods to be followed in order to reach a prosperous condition; from which it resulted that neither the private interest nor the public convenience were in any way served. They were governed entirely by routine, caprice and a bad imitation, the results naturally being an inevitable loss, discouragement and finally apathy. Established on spacious lands without any preparation of the ground, supply of pure water, cleanliness or healthy and nutritive food, continually converted into deposits of mud which were saturated with organic matters, that today would be taken advantage for the cultivation of pathogenic germs, judging from the phenomena that were frequently observed, such as the frequent cases of diseases in the cattle, the "Ranilla" (a vulgar name applied to a microbian affection of a typhoid character, the nature of which I was able to prove), carbon fever, sinthematic carbon and tuberculosis. The three first were characterized by hemorrhages and the latter by a chronic form with their invariable anatomo-pathologic lesions.

It is very much to be regretted that we have no statistical data at our disposal which relates to that period, and would better demonstrate the difference with the present conditions. These epizootic diseases probably found themselves in a favorable atmosphere and surroundings and constituted the principal obstacle to the preservation and progress of the dairy industry and the production of the elect for the breeding of different races of cattle.

Many animals that were imported for the purpose of improving the stock contracted one or other of the diseases above mentioned during the first days after arrival and succumbed in a few hours without any rational treatment being applied to them. This was the tribute that was naturally imposed by the ignorance of the causes and the disbelief in hygienic measures; but this ignorance has now happily terminated; hygiene took part in our legislature and the wise and prudent government that we now have, being convinced that the vic-

tories of science must necessarily be gradual, has inserted in the Sanitary Code of the Federal District provisions on the subject, whose benefits will reach the outermost confines of the Republic.

This Association has a knowledge of our Sanitary Code and of many of its regulations, including that which refers to the establishments now under discussion; a code that was formulated in view of past experience and scientific knowledge of the day. Once that law came into force the proprietors of dairies made the necessary arrangements to comply with its provisions. The establishments have been set up in a zone close to the suburbs of the city, in spacious grounds that will allow the cattle the necessary exercise, with yards for the separation of the young, for keeping and observing the animals attacked by contagious diseases, departments for the storage of food and dairy utensils; the soil has been cleansed and rendered impermeable; the liquid refuse is not detained; the food is healthy, abundant and varied as far as possible; they are all provided with an abundance of drinking water, the temperate climate which we enjoy allows the freest ventilation, the cattle are protected from the soil and the rains. The yards are cleaned daily, all these provisions being fully complied with, the dairies have actually become beautiful.

The Capital City contains 49 dairies with a total of 4081 animals. They are under the general oversight of an expert inspector who frequently visits the yards and examines the animals, besides making inspections when called upon. Those animals which are suffering from acute and contagious disease are taken away from the dairy and sent to the city slaughter house, where they are killed and cremated. These precautionary measures are carried out in accordance with strict rules for the transportation of sick animals or bodies which might present dangerous contagion.

We have now an establishment for the utilization of animal refuse, to which we send all kinds of matter that might be dangerous to men or animals, and where they are totally destroyed.

With respect to the treatment given to tuberculous animals it is both prudent and equitable. Once the disease is clinically demonstrated, the animals are taken from the dairy to the city slaughter house where they are killed and examined by the inspectors. Should the lesions be limited, the organs in which they are found are separated and the meat is delivered for public consumption, but if the lesions are extensive and in any way interest the circulation of the blood or of the lymph the whole carcass is cremated. As the clinical diagnostic does not give the inspector the certainty that he requires to separate the diseased animal in the dairies and send them to the slaughter house, advantage is taken of the bacteriological methods of

inoculation, and preferently of the Koch tuberculin, as the diagnostic becomes difficult when the lesions are incipient and on a small scale, whether situated in the lungs, internal ganglia or other organs, for which reason the present writer has adopted the application of tuberculin since June, 1895.

The bacteriological inspection is not omitted of the suspicious products, such as suppurated matter, pulp from the ganglia, expectoration, etc., and if this does not produce any results, the inoculation is proceeded with. As will be understood, this method is employed when external lesions are found in the lungs, when the softened products communicate with the bronchial tubes, as in this case we can obtain expectoration. The scrupulous character of the examination made by the inspector, obeys in the first place, the duty of complying with the regulations, and in the second, the necessity of procuring that the young animals shall have a healthy origin in order to stimulate the proprietors.

The regulations above cited provide an annual premium to be given to the dairy owners who show the greatest progress in the feeding and preservation of stock and the breeding of young animals in their respective establishments. This provision, like all the rest, was heartily accepted by the proprietors, and has commenced to produce excellent results. It is to be noted that when hygienic measures are adapted to the proposed end, they are well understood, inspire confidence, and are never forgotten. In order to take advantage of the benefits that might be produced from hygienic reforms, the dairy owners noted from 1895, when the regulations were issued, the disappearance of the "ranilla" and other fevers, of the abortions that were formerly so frequent, and in short the preservation of the health of the animals as well as the improved quality of the milk.

These facts, which have been continuously observed to this date, speak very highly in favor of the reforms and progress that have been made in the condition of the dairies. The measures taken to improve the breed of animals have brought about very satisfactory results, and the breeders in different parts of the country apply to these establishments to provide themselves with breeding animals at fair prices. A great reaction has taken place in this important industry, and the emulation between the dairy owners has reached such a point, that they strictly comply with the Sanitary Regulations and sometimes even go beyond them.

The progressive department of Fomento also takes its share in the good work and holds periodical expositions of cattle, fully complying with our regulations and giving excellent results.

The Supreme Board of Health in Mexico does not neglect the dairies in other parts of the Federal District; but in these places the introduction of the reforms is slower than in the Capital, and for this reason cases have presented themselves during the four years that have elapsed, of ranilla and other fevers, and with an almost mathematical exactitude it has been observed, that in those places where hygienic measures have been neglected, the number of deaths has been proportionately larger. At the same time, I cannot say that the proportion of deaths has been in any way remarkable, as the "ranilla" has only caused 12 per cent., the carbon fever 4 and 5 per cent., and the carbon sinthematic 8 or 10 per cent.

The circumstances that have been most successful in preventing the formation of active foci of contagion have been the timely intervention by the isolation of diseased animals, the disinfection of the places in which they were kept and the preventive inoculation of healthy animals. The preventive inoculation has been made with attenuated virus or toxines of extracts from filtered cultures. But as regards the immunizing action recognized in these liquids or attenuated virus, and in which I have great faith in view of the results I have personally obtained, I continue using the Pasteur vaccine against the carbon fever and the toxine of the "ranilla" microbe; but before applying them I make a trial on other animals and once I am certain that they preserve the necessary activity, I employ them. Both bring on a local lesion which consists of a painful hot tumor, and it is very necessary to note this, because when it does not appear, it is probable that the liquid has no activity and therefore no immunizing property. The attenuated cultures of a preventive character are generally put into the hands of experts, as they are the only ones who can make the necessary observations to prove their action and avoid the dangers that they might cause. They have the great advantage of being easy to prepare in the required quantity and in a short time.

We frequently find that the cattlemen confuse the curative remedy with the preventive, and seeing the danger remote, they do not inoculate their animals in time and thus present an opportunity for the invasion of their herds by epizootic disease. They then urgently demand the prophylactic in order to apply to the animals which they believe to be healthy, and for this reason the results are very often unsatisfactory. It is to be expected that the application of prophylaxis will bring about a reaction and that the cattle-owners will learn the necessity of making use of that method in due time.

The use of curative serums, when properly prepared, and which undoubtedly give good results, will in my opinion, not come into

general use on account of their high price, and we must therefore accept the attenuated or pure toxines, whose price is comparatively insignificant.

Amongst the cattle diseases above referred to, is tuberculosis, which, up to the present date and according to official data, appears to be on a small scale, and therefore need not inspire any great fears with regard to its transition to the human species. Neither is there any great danger of its transmission to the dairy animals or to the farms dedicated to the breeding of pure stock. According to the dairy regulations in force all the animals suffering from tuberculosis which are found in the dairies are separated and taken to the city slaughter house as soon as the facts are properly established.

The superintendent of the general slaughter house presents a report every year, to the Supreme Board of Health, showing the number of animals slaughtered for public consumption, as well as those that are found suffering from different diseases. From these reports I take the following data:

Years	Cattle slaughtered	Tuberculous animals
1895	85957	40
1896	89469	17
1897	94304	29
1898	95957	37

The greater part of these animals came from different states of the Republic and according to the official report above quoted it is very rare to find amongst them any tuberculous lesions. A small number come from the country parts of the Federal District, and the rest from the city dairies.

The Dairy Inspector of the City of Mexico reports that the present number of these establishments are now 49, and that the number of tuberculous animals forwarded to the slaughter house for killing in those years has been as follows:

In 1895	38
1896	15
1897	27
1898	30

Comparing these figures with the above we find that the largest number of tuberculous animals received in the city slaughter house came from the dairies of the city and the balance from the surrounding country, seeing that, as above said, it is an exception to find tuberculous lesions in the animals that come from the outside states.

According to the inspector, the number of animals existing in the dairies of Mexico City from 1895 to 1898 is 4,000 on an average.

Comparing this figure with those that show the number of tuberculous animals for the same year we find:

That in	1895	the number	per	1000	was		9.50
"	"	1896	"	"	"	"	3.75
"	"	1897	"	"	"	"	6.50
"	"	1898	"	"	"	"	7.50

We therefore see that the number of animals suffering from this disease in the most susceptible species, is in such a low proportion, that with the constant care which is taken the disease will certainly disappear, especially taking into account the fact that the purchasers of improved stock now demand certificates that the animals they purchase are bred of healthy parents and free from tuberculosis.

In view of the steps now taken amongst dairy owners to keep their establishments in a good hygienic condition, the Supreme Board of Health of the Federal District will undoubtedly approve of the new amendments now proposed in certain articles of the regulations in force.

I believe, gentlemen, that I have now given the American Public Health Association a clear idea of the history of the dairy establishments which exist in the Capital of the Republic, their progress and the prophylactic measures taken for the animals dedicated to that industry throughout the Federal District, although this does not cover all the reforms demanded by the regulations now in force.

RELATIONS OF LABORATORIES TO PUBLIC HEALTH.[1]

By WILLIAM H. WELCH, M. D., Baltimore, Md.

Mr. President and Members of the American Public Health Association—I am very glad of the opportunity of appearing before you, and desire to say a few words with reference to the general subject of the relations of laboratories to public health. A laboratory is a workshop where those, who are suitably trained, have charge of the work which is done, where they have the proper supply of material and adequate means for carrying out the study of such material. Such laboratories may be used for different purposes. Some of them we may regard as private laboratories; some as purely investigating laboratories; others are intended for purposes of instruction, and still others are mainly to make available to the general public the results of scientific work by the conduct of certain technical procedures. Laboratories in one form or another have existed from the earliest times. We must suppose that Aristotle had something in the nature of a laboratory, and although we know very little definitely about the remarkable Alexandrian period in medicine and science, it is clear that laboratories must have existed then. But public laboratories, which were freely opened for purposes of instruction and investigation, are modern. With the exception of the anatomical laboratory, which has existed in some form since the fifteenth century, laboratories, as now understood, are the creation of the present century.

It is usually stated that the first laboratory in a modern sense was the chemical laboratory founded by von Liebig in 1825. This is not strictly correct as a physiological laboratory was established by Purkinje in Breslau in 1824. It nevertheless remains true that Liebig's laboratory had the greatest influence upon the subsequent development of laboratories throughout the world, and to this day our chemical laboratories are the best supported and best equipped laboratories which we possess. I shall not attempt to trace the evolution of laboratories up to the present time. But it is of interest to note the very recent development of laboratories devoted to the study of hygiene.

The first laboratory of hygiene was started by von Pettenkofer in Munich and opened for students and investigators in 1878. It is rather surprising that the existence of public hygienic laboratories goes back only to that quite recent period, and those of you, who are familiar with the outcome of the foundation of that remarkable laboratory in Munich,

[1] Stenographic Report.

know that it was one which included all departments of hygiene in the broadest sense—the physical side, the chemical side, the bacteriological side of hygiene, all represented there by separate departments with the respective directors of these departments. What inestimable benefits it has brought to the city of Munich! In this laboratory were investigated the great problems relating to the disposal of sewage, the public water supply, the factors concerned in the prevalence of epidemic diseases, and more especially of cholera and typhoid fever. The well-known doctrine as to the relation of typhoid fever to ground-water was promulgated and thoroughly discussed. The result has been of inestimable value to the inhabitants of that city—a city which was once the very hotbed of typhoid fever, and which, at the present day, is practically free from it, so that I have heard von Ziemssen say that he has found it extremely difficult to give practical demonstrations to medical students of the lesions of this disease. The great work of von Pettenkofer and his coadjutors there cannot be expressed in dollars and cents.

A great impulse to the foundation of hygienic laboratories came about this period from the epochal discoveries in bacteriology. It was then that Koch introduced his remarkably simple methods for the isolation and study of bacteria of certain infectious diseases. The stimulus from these great discoveries led to the very rapid foundation of hygienic laboratories in connection with universities, so that within a few years nearly all of the great universities in Germany were provided with such laboratories. Another factor which has exerted a great influence in the development of hygiene has been the occurrence of epidemic diseases, more particularly such diseases as cholera, and in this country also yellow fever, and possibly it may turn out in the East that the plague may have a similar influence upon public sanitation there. Devastating as these diseases have been, it is a question whether the final outcome has not been on the whole to the advantage of the human race, because it does often seem as if it required the violent impressions of such pestilences to stir the people up to an appreciation of the needs of sanitation which are realized by sanitarians themselves, but who find it very hard to bring these matters to the attention of the public in a forcible way. As the result then of the very natural development of laboratories in general, of the developments in bacteriology and of the lessons of epidemic diseases, we have witnessed during the last twenty years the rapid foundation of hygienic laboratories connected particularly with universities, and with boards of health, both municipal and state. It is more particularly with reference to the latter laboratories, connected with municipal and state boards of health, that we are especially interested.

It will be appropriate to say a few words with reference to the development and organization of such laboratories, the important

results which have been achieved and the prospects which we can reasonably expect from their work. These laboratories, as you already know, have been founded in large number in this country, and, in fact, the development of laboratories connected with boards of health is one which is peculiarly American. The appreciation of the need of such laboratories, of what can be accomplished by them and of the benefits which the general public derive from them, has been greater in this country than elsewhere. We have led in this particular direction. The work of these municipal and State laboratories should in the first place, be put in charge of those who are especially trained in modern methods in bacteriology, in chemistry, in hygiene and in pathology. These are very generally the younger men who have had opportunities for these special lines of study. Such laboratories are, in a few instances, well supported, better supported than the laboratories in connection with universities. The kinds of work undertaken in these laboratories relate more particularly to practical problems concerned in the diagnosis, prevention and cure of disease; whereas the broader biological aspects are more properly considered in laboratories which belong to colleges and universities. But it has been difficult indeed for medical colleges and universities to supply suitable laboratories. They are expensive, and comparatively few of the educational institutions of this country are supplied with anything which is worthy of the name of a hygienic laboratory. I think one could count upon the fingers of one hand the laboratories connected with medical colleges or universities in this country which are appropriately called hygienic laboratories, not that hygiene is not represented in a larger proportion than that, but suitably equipped hygienic laboratories exist in small number in this country. This, of course, is to be very much regretted, and it is to be hoped that the influence of this Association may be such as to lead to a greater appreciation of the need of such laboratories in connection with our teaching bodies, because I think that such hygienic laboratories in connection with universities should work out problems that are different from those which interest municipal and state boards of health.

Let us consider for a moment some of the results obtained from such laboratories. As you all know, one of their main purposes is to assist physicians in making exact diagnosis of certain diseases. Their greatest triumphs are in relation to diphtheria, in the recognition of the cases of genuine diphtheria, on the one hand, and in seeing to it that specific treatment by antitoxin is properly carried out. But their field of usefulness is by no means limited to diphtheria, but extends to the diagnosis of other diseases, such as tuberculosis, typhoid fever and malaria. While often tuberculosis is readily recognized by the physi-

cian, once in a while cases occur in which the physician must be in doubt as to the diagnosis, and he should be able to call to his aid those who are working in these laboratories for the purpose of enabling him to make a correct diagnosis. The diagnosis of fevers, such as typhoid and malarial fever, offers an important field of usefulness for these laboratories, particularly in the south. In the recent war we are told that the diagnosis of typhoid fever was made with great reluctance, and that physicians often made a diagnosis of malarial fever in many cases of genuine typhoid fever. We have means at our disposal for the accurate diagnosis of these two diseases. The diagnosis of typhoid fever can frequently be made with the Widal reaction, and it looks now as if there were to be other methods added which will enable us to make a diagnosis at an earlier stage of the disease than where the Widal reaction is applicable or in cases where this reaction fails. Especially to be desired is the establishment of laboratories available for the diagnosis of malaria in the regions where malaria prevails, particularly the severe forms of the affection. Nothing should be called malaria unless the malarial parasite is present, and an exact diagnosis of the disease can be made by samples of blood properly collected. With a little instruction the physician should be able to send these specimens in such a way that a report could be returned within a short time as to the existence of malaria. When we consider the practical importance of these two diseases in this country, and the fact that typhoid fever is preventable and that the recent discoveries regarding the relation of the mosquito to the spread of malaria offer prospects of eradicating malaria, the importance of extending in the direction indicated the work of municipal and state laboratories is apparent.

Then, there is the chance of one of the greater devastating epidemics making its appearance. The municipal and state boards of health can make early diagnoses. Thus if Asiatic cholera should make its appearance, effective measures of prevention can now be taken at the onset, for it is important to recognize the first case of the disease before it can gain a foothold. The experience during the last cholera epidemic in Germany was that when the first cases were recognized and immediate measures were taken to check the spread of the disease, those measures were very effective. But where the disease was allowed to gain a foothold, it was difficult to put an end to the epidemic. Suppose the plague should make its appearance in this country; if the city or State is provided with a suitable laboratory, with well-trained physicians, the first case or two should be recognized and effective measures of prevention should be taken, so that these laboratories should stand as an effective defence between us and the outbreak of this great pestilence. It is not clear that these laboratories can be so useful with reference to

the diagnosis of yellow fever, because here we have not exact methods, still they can be helpful in many directions with reference to this disease.

These laboratories can carry on original investigations and important practical work with reference to water supplies, to the disposal of sewage, to examinations of food, of milk, etc. All of these are subjects which properly pertain to some aspects of the work of laboratories, but I shall not attempt to consider them now. The foundation of such laboratories has had a very important stimulating influence upon boards of health, both local and state. It has introduced a scientific spirit into the work; it has brought into connection with executive officers the younger men who are full of enthusiasm with reference to studies along these lines, and I think that we may say that the general tone of boards of health has been elevated and stimulated by the foundation of laboratories of this character.

It is to be deplored that our National Government has had so little share in this important movement in public hygiene. This Association has advocated a plan by which the various States may secure aid from the National Government for the support of public laboratories of hygiene analogous to that in operation in the case of Agricultural Experiment Stations, and it seems to me very desirable that this or some similar plan should be adopted. Then we are all agreed that our government should have a central sanitary organization in connection with which a laboratory of public hygiene should be established. We can now appeal as never before to the furtherance thereby of commercial interests, a motive which seems to be more efficacious with our legislators than the lives and health of human beings, possibly even more than the welfare of cattle.

Many of you know that the workers in these laboratories have come together on this occasion in unusual numbers, largely through the very excellent work of our public-spirited member, Dr. Wyatt Johnston. These workers have been brought together here with a view to organizing a Laboratory Committee or Section of this Association. A few years ago a somewhat similar meeting of bacteriologists was held under the auspices of the Water Committee of this Association in New York, and we all felt at that time that it would be fortunate if we could have a permanent organization composed of such men as were there assembled. In fact, the idea of organizing the working bacteriologists and allied chemists into a biochemical section has been in the air for some time, and the outcome seems to be the best form of organization, viz: one which will bring these experts into this Association. What we propose to do is to bring them as a group here and have them become members of the Association. There are many questions which

are very technical, relating to methods of procedure, etc., which it would not be at all appropriate to bring before the general body of the Association, such as chemical examinations of water, classification of water bacteria, etc., etc. It is proposed, therefore, that this relatively small group of members of this Association shall constitute a subgroup—call it what you like. I do not think Laboratory Committee is a designative term, in that it does not express exactly the scope of the work. However, matters of detail can be readily settled by a conference committee. The idea is that we should be called a section of this Association, which shall assemble here at the same time that the general Association comes together, but that the meetings of the smaller body or section shall take place on the day preceding the meeting of the general Association, and, if possible, their special work should be completed then. If any work remains over, provision should be made for finishing it without conflicting with the sessions of the general body. Subjects of special interest only to the practical worker should be discussed before the meeting of the section, and members of this section having papers of general interest should present them before the Association. The details of organizing such a section can be worked out later. It is clear to us, however, that none should be eligible to membership in the section who do not become likewise members of the American Public Health Association. That is our understanding, and we ask no special autonomy other than that we shall come together in connection with your meeting by such an arrangement as will be mutually advantageous, increasing your membership in quantity and quality, bringing certain kinds of members whom, I am sure, you will all be glad to welcome here to add to the usefulness of the Association. It will be of advantage to bacteriologists to come into close contact with the practical work of this Association, and to this Association to receive these workers.

OFFICIAL REPORT OF THE PROCEEDINGS OF THE TWENTY-SEVENTH ANNUAL MEETING OF THE AMERICAN PUBLIC HEALTH ASSOCIATION.

HELD AT MINNEAPOLIS, MINNESOTA OCTOBER 31ST, AND NOVEMBER 1, 2 AND 3, 1899.

OCTOBER 31ST—FIRST DAY—MORNING SESSION.

The Association met in the First Unitarian Church, and was called to order at 10 A. M. by the President, Dr. Henry Mitchell, of Asbury Park, New Jersey.

The first thing in order was announcements by the Chairman of the Local Committee of Arrangements, Dr. R. O. Beard.

Dr. Beard presented the following report:

REPORT OF COMMITTEE OF ARRANGEMENTS.

Your Local Committee of Arrangements desires to report to you that all the regular meetings of the Association, including the open meeting of this evening, will be held in this church, and that rooms are available for Committee purposes, adjoining the audience room on my left,—both on this floor and the floor above. The headquarters of the Association Treasurer will be found in the small parlor through which the church is entered—upon my right. In the same room will be found the headquarters of the Committee on Information. After the members have obtained their credentials from the Treasurer they will please present them to the Committee on Information. From this committee they will then obtain the Association badge or button, the souvenir of the meeting, the programs, and the announcements of, and the invitations to, the several entertainments offered to the Association. Let me add that among these will be found an invitation extended by the Minnesota Academy of Medicine to the Association for a "Smoke Social," to be given at the West Hotel tomorrow evening, at 8 o'clock, and an invitation from the citizens of Minneapolis to a general reception to be given at the West Hotel, on Thursday evening, at the same hour. I wish to call the attention of those of you—we hope a large number—who are accompanied by ladies, to the little announcement of the Ladies' Committee of Reception for their entertainment. In the basement of the building is a large room in which exhibits of sanitary apparatus and materials will be made.

The programs of the meetings will be issued daily and will be distributed at the church.

At the opening meeting of the Association to-night, addresses will be made by the Mayor of the city, the Hon. James Gray, the Hon. John Lind, Governor of the State, by the President of the Hennepin County Medical Society, and by President Northrop, of the University of Minnesota.

The railroads of the United States and Canada have granted a rate of one and one-third fares for the round trip to members attending the Association meeting.

The method of this arrangement is as follows: Members will present their tickets or receipts for transportation obtained from local agents to Dr. H. M. Bracken, of the Committee of Arrangements by Thursday morning. Dr. Bracken will sign the certificate of membership for this purpose.

On Thursday, during business hours, a joint agent of the railroads will be present with Dr. Bracken at the Bureau of Information for the purpose of issuing orders for transportation to returning members at the reduced rates.

THE PRESIDENT.—The next thing in order is the reading of the minutes of the last annual meeting.

DR. SWARTS.—Inasmuch as the time is somewhat limited and the minutes have already been published in our annual volume of transactions and have probably been read by the members, I move that the reading of them be dispensed with. Seconded and carried.

THE PRESIDENT.—The next order is the report of the Executive Committee and the election of members, which will be presented by the Secretary.

THE SECRETARY.—I have here a long list of applications for membership which have been recommended for election by the Executive Committee. (See Appendix.)

THE PRESIDENT.—You have heard the reading of the list of applicants for membership. What disposition will you make of these applications?

DR. WM. BAILEY.—I move that the Secretary be instructed to cast the ballot of the Association for the election of those gentlemen whose names have been read. Seconded and carried.

The Secretary then cast the ballot of the Association, and they were declared duly elected members of the Association.

THE PRESIDENT.—We will now re-open under No. 4 of the program and continue the report of the Executive Committee.

THE SECRETARY.—The following resolution was offered before the Executive Committee, and the Executive Committee recommends it to the Association for adoption.

Resolved, That paragraph IX of the Constitution of this Association shall be construed to place upon the roll of ex-presidents and members of the Executive Council all persons who shall have performed the duties of President to fill a vacancy caused by the death or resignation of the president-elect.

DR. BENJAMIN LEE.—I move that the resolution be adopted. Seconded and carried.

THE PRESIDENT.—If there is any other business which any member desires to present at this time, he can do so, otherwise we will proceed with the scientific part of the program.

Dr. H. B. Horlbeck, Chairman, Charleston, S. C., read the "Report of the Committee on the Etiology of Yellow Fever." (See page 24.)

Dr. Eduardo Licéaga, of Mexico City, Mexico, followed with a paper entitled (a) "Description of Sanitary Stations About to Be Established in the Mexican Republic to Prevent the Spread of Yellow Fever," and (b) "Eighth Report Presented to the Committee on Yellow Fever of the Cases Observed in the Mexican Republic, from the Date of the Last Report, September the 12th, 1898, to September 15th, 1899." (See pages 33, and 37.)

Dr. Narciso del Rio, of Vera Cruz, Mexico, followed with a paper on the "Necessity of Making a Complete and General Disinfection of a Vessel in Order to Make It Efficacious, Proving that Partial Disinfection Is Useless in Cases of Yellow Fever." (See page 42.)

Dr. Antonio Matienzo, of Tampico, Tamalipas, read a paper on "Yellow Fever a Preventable Disease." (See page 49.)

DISCUSSION OF THE PAPERS ON YELLOW FEVER AND DISINFECTION OF VESSELS.

DR. THOMAS J. TURNER, U. S. Navy, of Coldwater, Michigan.—With reference to the disinfection of vessels, I have some reminiscences in regard to that matter which may be of sufficient interest to relate did time permit. As most of you know, I am a retired medical officer of the Navy, and I have had considerable experience in the disinfection of ships. That absolute and thorough cleanliness is essential goes without saying, and heretofore we have largely depended upon steam heat. I have had some experience with sulphur dioxide fumes, and this agent does not seem to meet the necessary indications so far as thorough disinfection is concerned.

As to formaldehyde as a disinfectant, I must confess that I have not had very much experience with it. Speaking of the disinfection of houses and other things, I have used formalin solution in the form of a spray, but how long the formaldehyde remains effective in this form I am not prepared to say. I will not detain you any longer than by stating, that disinfection to be useful should be general, thorough and absolute. This applies to yellow fever as well as to other contagious diseases. I am one of those who believe that the germs of yellow fever are not carried by persons themselves, but by various articles. My experience with two epidemics that occurred in 1878 and 1879 and observations in Rio Janeiro, convinced me that the germs of the disease are not carried by persons.

Dr. C. P. Wilkinson, of New Orleans, La.—I desire to say a few words in relation to the disinfection of vessels. The Louisiana Quarantine Service employs heat, dry and moist, for all textile fabrics. The washing is done with a solution of bichloride of mercury, 1-800, and the use of sulphur dioxide fumes. The cabins and holds of vessels are washed with a solution of bichloride of mercury, particularly the holds, when not filled with cargo. We add to this disinfection sulphur dioxide fumes. There is a great deal of moisture in our atmosphere, but heat is not applied in dry form. Formaldehyde is used extensively by the United States Government in Havana for disinfecting all materials that are shipped to leading points in the South. At Fort Henry baggage is disinfected by formaldehyde and steam processes. They can readily substitute the steam process of disinfection for formaldehyde for textile fabrics because they have a plant in operation. Parts of a vessel can be thoroughly disinfected by the burning process by lamps. In applying disinfection throughout the South in the last few years for the prevention of yellow fever, it has been deemed necessary to burn a great deal of poor material. Some houses have been burned, also a great deal of bedding and wearing apparel. Articles worthy of being saved were saved. Steam disinfecting apparatus were used in some places; other localities were subjected to sulphur dioxide fumes, moist heat, and the application of formaldehyde. Formaldehyde has taken a decided and positive stand as a disinfecting agent for the suppression of contagious diseases. I believe it will be used in almost every city for the prevention of scarlet fever and diphtheria. Yesterday I had a conversation with Dr. Reynolds, Health Commissioner of Chicago, as to the method employed in that city. The method is very practical, and is in general use there. They have one or two sheets, according to the size of the room; formalin is sprinkled on the sheets, and as the gas evaporates rapidly the disinfectors have to leave the room as quickly as possible. The objection to hav-

ing the sheet thoroughly saturated is that the formalin will run through and be deposited on the floor, so that offensive odors are emitted from the room for some days thereafter. So far as the disinfection of vessels is concerned, the most important part of the disinfection of a vessel, or any place where there is a contagious disease, is the place inhabited by human beings. After considerable experience in disinfecting thousands of vessels, I am strongly of the opinion that the holds are not relatively dangerous, not even the cargo, the engine room, or coal bunkers, as these are rarely touched by anyone. The most dangerous portion is that inhabited by human beings, the sailors in preference to the officers, because they are more unsanitary. A greater number of sailors than officers are exposed.

Methods of disinfection of a vessel to be successful should be addressed mainly and positively to the inhabited portions of it, the apartments, sleeping berths, etc. You should always use steam heat, bring the temperature to 220°, and allow it to stay at that point for thirty minutes. Of two thousand vessels subjected to disinfection on that principle, we have only had four on which yellow fever has subsequently appeared. That is an infinitesimally small percentage, hardly worthy of consideration. The outbreak of yellow fever on those four vessels may have been due to insufficient disinfection. I am strongly of the opinion that the detention of a vessel is practically of no advantage in preventing contagious diseases, and is a great detriment to the passengers. The employment of advanced measures of disinfection is very essential, and I do not think this or any other Association has fulfilled its duty until we keep abreast of the times and give to the various members all the information we can possibly collect on this subject.

Dr. Thomas J. Turner, U. S. Navy, of Coldwater Michigan.—I have used the method of sprinkling formalin upon sheets in quite a number of instances, or with spray producer, and it makes one hustle very soon, on account of the rapid diffusion and evaporation; and active disinfection is accomplished by an atomizer or by sprinkling the formalin on sheets.

Dr. Frederick Montizambert, of Ottawa, Ontario.—I had a little experience with a vessel this year in connection with an outbreak of smallpox. The facts were these: A vessel arrived direct from the Black Sea at the St. Lawrence Quarantine, and I was sent there to strengthen the hands of the local men in dealing with a somewhat unusual outbreak on that vessel. There were twenty-three hundred emigrants on this comparatively small vessel, and the vessel arrived with seventeen cases of smallpox on board. Our system of disinfection, as

I have repeatedly informed the Association on previous occasions, is to use steam heat where it can be employed. Sulphur dioxide for large compartments, formaldehyde for those smaller, yet too large or unsuited for steam, and bichloride of mercury of the same strength as that mentioned by Dr. Wilkinson, thoroughly flushing the latrines, etc. For storages and holds, we generally use sulphur dioxide fumes; driven in from the blast furnace, but on this occasion I was not able to avail myself of them, and I used formaldehyde to an extent that I had never done before with a vessel. We had to use it in all compartments, large and small, as well as in the living rooms of a few of the better class accompanying these emigrants. They were what might be called saloon passengers, as well as the officers. The ship was listed to sail on a certain day, but it was a little behind time. Her agents were extremely anxious to have her at once and we were telegraphed, asking if we would release the ship, and we replied that if they were prepared to send a new crew we would let the ship go as soon as disinfected. We disinfected the ship thoroughly with formaldehyde; a new crew of about forty men was furnished; the vessel swung without crew at is anchor; the new crew immediately went on board and lived in these rooms which had been infected by these people. There were six cases amongst the crew, and eleven amongst the passengers in all parts of the vessel. There were twenty-four hundred people on board this ship altogether; the infection had extended to all parts of the ship. The first crew was sent by a sister ship that happened to be in port. They sent a crew to bring her up to the port. When she arrived, the crew that had brought her up from quarantine went back to their ship and a new scratch crew was obtained for her at Quebec. Thus, within three days after the completion of the disinfection with formaldehyde, two sets of men entered and lived in those parts of the vessel which Dr. Wilkinson has properly designated as the most dangerous ones. It is possible that they were protected by vaccination, but I cannot give any positive information in regard to that point. I recommended that the first new crew should be vaccinated; I could not insist on it, as the vessel was claimed to be free of danger. How far my recommendation was carried out with the first one, I do not know, but I have no reason to believe that it was carried out at all with regard to the other. This happened about four months ago. There has been no trace of recurrence, nor has any case arisen from it. I thought the circumstances and facts of this outbreak might be of interest to the Association.

Dr. Louis Victor Cabana, of Fall River, Mass.—In a smallpox epidemic which we had a few months ago, formaldehyde was used as a disinfectant, also the disinfectant called "germool." Strips of paper were used to cover all openings to prevent the escape of the formalde-

hyde. We have a special instrument which we use for this purpose, and in the space of three or four hours, after the room is completely filled with the vapor of formaldehyde, it is perfectly safe to open it. We have used formaldehyde as a disinfectant in connection with the work of the Board of Health for the last two or three years and are perfectly satisfied with it.

Dr. Liston H. Montgomery, of Chicago, Ill.—I would like to ask Dr. del Rio as to the number of deaths from yellow fever at Vera Cruz. The reason I ask this question is, that a personal friend of mine, whom I regard as a very intelligent man, returned from a short residence in Vera Cruz during the past summer, and told me that from March until July he had seen a large number of funerals passing along the streets in Vera Cruz daily, the deaths being due to yellow fever. Indeed, he went so far as to say that he saw from fifty to sixty funerals a day. Of course, I took this statement with a good deal of allowance.

Dr. del Rio.—In answer to Dr. Montgomery, I desire to state that there is no truth in the statement of so many funerals having taken place in Vera Cruz in one day or week from yellow fever.

Dr. Horlbeck (closing the discussion.)—In reference to the etiology of yellow fever, I have tried to indicate to you the efforts of the Committee in endeavoring to have a number of men sent to some of the centers of yellow fever to study the disease thoroughly. There is a great deal of mystery connected with this disease, as we know so little about the cause of it. Of course, there are many surmises about this and that, but nothing in the nature of absolute facts is known. There have been various observations made by different observers, some stating that the infectious center may be limited to a street and may be kept within its confines, others believing that it takes a much greater scope and passes far beyond a street. These views have been held, but none of them are based on absolutely known facts. The members of your Committee have been twice to Washington to get competent bacteriologists to go to one of the yellow fever centers to study the disease. I cannot urge upon the Association too strongly the importance of the members using such influence as they may have on our government officials to try, sooner or later, as I believe it will come, to follow the great example of Germany, that sent out Koch to study cholera, and the world now recognizes the vast benefit his investigations have been to mankind. Recently Dr. Ross was sent to study malaria and the mosquito as a causal factor. So I cannot see why this government should not do a similar thing by sending a special bacteriological commission to the yellow fever centers to study the disease. Some such movement ought to be made. I do not know exactly how

it can be carried out, whether the investigation should be conducted under the auspices of one of our universities or not. The future will decide in regard to this point. There are at least twelve millions of people in the Southern States who are imperiled from this disease, besides the immense number of people who are directly interested commercially when this disease appears amongst us in the summer months. As I have previously said, I cannot too strongly impress upon the Association the necessity for some definite scientific knowledge, to find out exactly what this micro-organism is. It is true, a great deal of work has been done in regard to the supposed germ of yellow fever. We have learned a great deal about the tubercle bacillus, and there is more to be learned about it, and there is much more to be learned regarding the bacillus icteroides of Sanarelli, even if it proves to be the specific micro-organism of yellow fever. It is well-known that a great many eminent men believe it is the cause of yellow fever, while other equally distinguished believe it is not. We need a more intimate and definite knowledge regarding the points affecting the life habitat of this micro-organism and its limitations. It seems to me, the only proper way to do, and the only way likely to be successful at all, is to investigate this disease more thoroughly and determine its cause. For this purpose we should have men competent to undertake the work. It ought to be conducted on a large scale, and sufficient remuneration should be provided to warrant the employment of men whose labors are worth something. Exactly how this is to be done, I do not know. I have only thrown out the suggestion of the appointment of a bacteriological commission to give you food for thought in your consideration of this very important subject. It is our duty to bring this matter to the attention of our government officials and let them realize and understand how extremely important it is that something should be done in regard to this disease. If the real germ of the disease is discovered, it will be a source of satisfaction to us that we have been directly connected with its discovery.

Dr. Juan Breña, of Zacatecas, Mexico, read a paper on "The Influence of Forests on the Public Health." (See page 56.)

On motion of Dr. A. C. Hunt, a paper by Prof. John T. Smock, of Trenton, New Jersey, was read by title. The paper was entitled "The Relation of Forests to the Public Health." (See page 68.)

DISCUSSION OF THE PAPER OF DR. BREÑA.

Dr. Benjamin Lee, of Philadelphia, Pa.—I have on previous occasions urged upon the members of the Association the importance of organizing forestry associations in their several States. I believe that voluntary associations of this kind can do very much towards educat-

ing people in this important matter. There is, however, in our State another feature which I think is going to work great good, and that is what we call "Arbor Days." On these occasions the entire session of the public school is devoted to questions pertaining to the effect of arboriculture on the public health and the prosperity of the State. One portion of the exercises consists in tree planting. This is of great interest to the children and is an object lesson which they never forget. The trees which are planted one year are visited the next year, and their condition is carefully studied. If it is found that certain trees have failed, others are planted in their places, and new trees are also planted. In this way there is a practical education of the children of the State as to the value of forests which must result in the next generation in very important results.

Dr. H. M. Bracken, of Minneapolis, read a communication from the chief (forest) fire warden, of St. Paul, asking whether it would not be advisable for the Association to give some favorable expression for the National Park as a health resort. He thinks the medical profession can be very influential in securing some of the pine forests for a health resort. In a few years it will be too late.

Dr. Bracken stated that a National Park and Forestry Association had been organized in Chicago, the idea being to preserve most of the Norway pines in Minnesota. These forests can be utilized as places of recreation and rest.

Dr. Gardner T. Swarts presented the following resolution, which was referred to the Executive Committee:

Resolved, That this Association believes that the presence of trees in large numbers are conducive to the preservation of the public health;

Resolved, That the Committee on Relation of Forests to the Public Health be requested to use its influence in securing the preservation of the forests of Minnesota for a National Park.

On motion of Dr. Bailey, the Association then adjourned until 3 P. M.

FIRST DAY—AFTERNOON SESSION.

The Association re-assembled at 3 P. M., and was called to order by the President.

The first thing in order was an Address by Prof. Wm. H. Welch, of Baltimore, Md. He selected for his subject "The Relations of Laboratories to Public Health. (See page 460.)

Mrs. Ellen H. Richards, of Boston, Mass., read a paper on "University Laboratories in Relation to the Investigation of Public Health Problems and to Commercial Work." (See page 73.)

Dr. Wyatt Johnston, Montreal, P. Q., narrated his "Personal Experience in Disinfection." (See page 81.)

DISCUSSION ON DR. JOHNSTON'S PAPER.

Dr. C. P. Wilkinson, of New Orleans, La.—I would like to ask Dr. Johnston a question. He made a statement with reference to the dry method in using formaldehyde gas, and stated that the heat had a good deal to do with improving the efficacy of the gas. I would like to have him tell us to what degree of heat the room should be brought in order to get that improvement?

Dr. Johnston.—I might say, that I did not have reference so much to the heat which can be obtained in a room as the hot air temperature in the autoclave. The heat is not sufficient to scorch the clothing. It would represent fifty degrees C. With this heat we could reduce the period of exposure an hour or more and get a good deal of penetration.

Dr. Amand Ravold, St. Louis, Mo.—In connection with the subject of disinfection, I wish to speak upon the important question of the disinfection of railroad coaches. I would like also to ask Dr. Gehrmann to explain the method pursued and recommended by the Chicago Health Department, because from the disastrous experience which followed its use in St. Louis last winter, we were compelled to condemn it. A man sick with smallpox traveled from a distant city to St. Louis in a Pullman sleeping car. The car was disinfected by the method adopted by the Pullman Company,—that recommended by the Chicago Health Department—and after its disinfection it was scrubbed and cleaned by a negro who had not been near the car before its disinfection, or, to his knowledge, had been in contact with a case of smallpox. Fourteen days after cleaning the car, the negro developed smallpox, was removed to smallpox hospital and died there. The Health Commissioner, Dr. Max C. Starkloff, immediately ordered an investigation by the Bacteriological Division, of the disinfection method, as conducted by the Pullman Company. The weather was cold at the time (March, 1899), and we found that a car about to be disinfected was first thoroughly heated; the berths then opened and sheets were suspended from the bell rope along the length of the car; formalin was then sprayed evenly over the sheets in quantity and with an apparatus used and recommended by the Chicago Health Department; the car was then tightly closed and kept so for several hours. Into such a prepared car we exposed the simplest of our test objects: Cover glasses upon one side of which a twenty-four hour old culture of a virulent diphtheria bacillus (Park No. 8) had been thinly spread; they were placed on the floor and at different heights about the car. After six hours and ten minutes exposure the car was opened, the test

objects removed and each cover glass was put into 10 c.c. of sterile broth. All of the test objects showed a vigorous growth of the bacillus after twenty-four hours incubation at 37° C. We afterwards carried out other experiments with this method in our disinfection chamber with equally unsatisfactory results.

The St. Louis Health Department early in its experiments with various kinds of apparatus devised for formaldehyde disinfection, discovered that in order to obtain the best results with the gas, it was essential to have the air of the room saturated with moisture. It was while experimenting to discover the best method of evaporating water in a room, that Mr. Chas. W. Francis, Chief Sanitary Officer, stumbled upon the method now used by us; that was in January of the present year. The method proved so efficient and simple that we were quite jubilant with our success and ready to publish our results when the December number of "Zeitschrift für Hygiene" reached us. It contained an identical method devised by Prof. Flügee of Breslau, and is now known as the Breslau method.

Our method is as follows: A copper bucket containing water is placed upon a tripod; the tripod stands upon a large square sheet of asbestos; beneath the bucket is placed a cup containing mineral wool into which wood alcohol is poured; the cup sits in a shallow dish, so that, if by accident the alcohol should leak out of the cup, it is caught in the dish beneath. With everything in readiness, the alcohol is lighted and when the water in the bucket boils formalin is poured into it, in the proportion of one part of formalin to three of water. In dwelling rooms twenty ounces of formalin are used to 1000 cubic feet; in parlors, libraries, etc., less formalin and water are used. Rooms are kept tightly closed five (5) hours. The method is so simple that any politician can understand it, and the apparatus is not easily injured. The formaldehyde does not polymerize in the bucket. Diphtheria and typhoid bacilli are killed in thirty minutes, and occasionally—not every time—we have killed anthrax spores on cover glasses in five hours.

Dr. E. K. Sprague, Marine Hospital Service, Washington, D. C.—Dr. Johnston spoke of the results to be obtained with a vacuum in connection with formaldehyde disinfection, and said that he did not see it was of any special benefit. I agree with the Doctor entirely if he uses formaldehyde at ordinary temperatures. This summer I conducted some experiments upon that subject. I used a cylinder with a vacuum apparatus, with which I could readily obtain a vacuum of half an atmosphere, fifteen inches. To this was attached an apparatus similar to the autoclave, heated by steam coil. Anthrax, typhoid and diphtheria bacilli were buried in various articles. In the chamber there were placed mattresses, pillows, hairs and feathers, blankets, and old cloth-

ing, such as we might encounter at disinfecting stations. With 500 c.c. of the formalin solution with a vacuum of half an atmosphere, one hour exposure, the only organisms killed were those of diphtheria and typhoid on the surface. We used layers of cheesecloth, perforated, and the bacteria were on slips of old toweling that had been previously sterilized and immersed for a few minutes in bouillon culture. The bacteria in the other articles—mattresses, pillows, and blankets—were not affected in the least. They grew readily. These experiments were repeated to prove that with a vacuum, and a large percentage of formalin, 50 per cent., surface disinfection was all that we could expect. The cylinder had a steam jacket in which the steam could be turned on and the jacket heated to 90°. The method which I employed was to heat the jacket to the required temperature, then put the cultures and the articles into the chamber, close the door, and exhaust the air, start the formaldehyde going, and I timed it from the moment that I opened the valve to allow the formaldehyde to pass into the chamber. In the course of a few minutes the formaldehyde was driven off. I closed the the formaldehyde apparatus, and allowed it to remain in the chamber for thirty minutes. Anthrax spores under these conditions, with a temperature of 90°, were readily killed. Of fourteen experiments, I was successful in twelve. In two I had failure on account of using a small quantity of the formaldehyde solution, there being only 360 c.c. in the generator when I should have used from 500 to 750 c.c. and even 1000 c.c. I was uniformly successful in killing anthrax bacilli with dry heat at 90°, as well as diphtheria and typhoid germs with the addition of formaldehyde. After thirty minutes had elapsed, I drew out the formalin by means of a vacuum, which had been reduced somewhat, and allowed the ammonia generator to work in the same manner, consuming only a few minutes with that process, and I found half as much ammonia as formalin solution was sufficient to neutralize the formaldehyde, after I had pumped in what I could with my vacuum apparatus. There was some formamide formed by the action of the ammonia, and I think there is no question but what the mattresses were in poor condition to sleep on that night. At the end of several hours we got a decided odor from formaldehyde. The use of more ammonia will remove the odor better than if we had exposed the articles to the air. This is a matter of trifling importance, and if we thoroughly disinfect articles we can afford to wait an hour or two, or a few hours, for the formaldehyde to disappear.

Dr. M. P. Ravenel, of Philadelphia, Pa.—It seems to me that the difference of opinion as to the efficiency of formaldehyde disinfection is partly due to the difference of methods in testing its disinfecting properties. Dr. Ravold believes that spreading a culture on a cover-

glass is the easiest way of killing the bacteria. I think it is one of the hardest when formaldehyde is used, for the reason that the glass protects the under layer of the bacteria, while we have an impenetrable layer on top, formed by some chemical reaction between the albuminous matter in the culture-medium and the formaldehyde. If he will try the use of filter-paper saturated with a suspension of a fresh culture, and alongside of that a cover-glass spread in the way he spoke of, and subject them to the same treatment, he will find the culture on the filter-paper killed while that on the cover-glass has not been injured. In this matter, as well as in other things, I think we should adopt a standard method of examination when testing disinfectants.

I would like to ask Dr. Johnston if he has used glycerine in conjunction with formalin? My experience with formaldehyde has been rather curious. When formaldehyde was introduced, I made several laboratory experiments under a bell-glass and found it efficient, so decided to try the various apparatus that were constructed by the sanitary companies, for room disinfection. I also tried Schering's lamps, and in every single instance I failed absolutely. I was unable to kill prodigiosus, fresh cultures of typhoid fever, etc. I was disheartened, and remained so practically until the glycerine method was introduced. I then used very much the same apparatus which is advised by Professor Novy, and with the addition of 10 per cent. glycerine to the formalin, I have repeatedly killed every culture which I have tried except anthrax spores on silk threads. I have never succeeded in killing these. This I have done in rooms of 5000 cubic feet capacity, sealing up the large cracks with Manilla paper, but making no special attempt to seal up the smaller ones. Stove-pipes and ventilators must be closed.

In connection with what Dr. Sprague has said, I do not think his work is a fair test for formalin disinfection because of the addition of 90° temperature. Such a temperature will kill the vast majority of non-spore-bearing bacteria by itself. It is no doubt an excellent thing to have a rapid method for quarantine disinfection, but that does not help us in house to house disinfection during an epidemic.

Dr. Adolph Gehrmann, of Chicago, Ill.—I agree with Dr. Johnston thoroughly as regards the utility of formaldehyde disinfection, and the number of cases for disinfection since its introduction as a disinfectant have increased fifty per cent.

A few words as to the method of disinfection which is employed by the Chicago Health Department. We use the sheet method exclusively. There is only one point of which I can speak especially, as the matter has already been referred to, and reported to the Association last year. Our sheets are suspended by a cord, not laid over a line,

one sheet being used for each thousand cubic feet, and upon the sheet is sprayed six ounces of a 40 per cent. solution of formaldehyde, the spraying being done, so that single drops of formaldehyde are placed upon the sheet. By this method we are able to disinfect the surface of all suspected material.

As to the Pullman Car Company method of disinfection, I am hardly in a position to state anything very definitely. I know that this company has adopted the method that we use, and they have issued some instructions regarding it, but just what those instructions are I cannot recall. Our time limit for disinfection is five hours, and longer if it is possible. The majority of house disinfections are performed between nine and eleven o'clock, and the rooms are to remain closed until time to prepare the evening meal. I have also found in my experiments that the preparations on cover-glass slips is one of the most difficult objects to disinfect or to get the bacteria destroyed. The reason formaldehyde has so little penetrating power, and the reason it does not kill bacteria is because it combines quickly with albumin, producing some inert compound, and does not penetrate the deeper structures.

Dr. J. N. Hurty, of Indianapolis, Ind.—I have had some experience in disinfecting ordinary railroad coaches. The method pursued was to use a large atomizer which was propelled by air under pressure. At the terminals of all the railroads the companies have compressed air stored in large iron or steel tanks as large as locomotive boilers, under a pressure of from 75 to 100 pounds. One use of this compressed air is for blowing dust out of the cushions of the cars. They take the seats out of the car, and with compressed air can blow the dust out of the cushions completely. I think the idea of using steam for atomizing formaldehyde would be excellent. The plush is not at all injured by moisture, and it can be wiped off. There would be little use of suspending sheets for spraying with formaldehyde in plush upholstered cars. The workman who attends to the disinfection of cars at the Big Four Railroad terminals has his nose and eyes protected. The disinfector enters the car, goes to the far end, armed with a solution of 40 per cent. formaldehyde mixed with 3 per cent. of glycerine, and as he backs out, the atomizer being under heavy pressure, fills the car with a nebula of the formaldehyde, blowing it all over the car. He backs out rapidly, although nose and eyes are protected, for the gas is rapidly evolved and becomes unbearable. I desired to know whether this disinfection amounted to anything as in his rapid work the man probably will not spray every seat thoroughly, but perhaps 60 per cent. of them will be sprayed and the atmosphere will be surcharged with formaldehyde gas. Some smears of diphtheria bacilli

were placed upon cheesecloth and pinned to the backs of seats, and in every instance, after this method of disinfection, the bacilli have been destroyed. I have never been able to get a growth from these exposures. This method of disinfection does not in any way affect the curtains or hangings in the car. I am confident experiments will sustain my experience in this regard.

Not long since I had occasion to disinfect a church, a young girl who attended the church, having been found therein in the pustular stage of smallpox. Four pounds of formaldehyde were mixed with 5 per cent. glycerine, and diluted with two gallons of water. All openings were closed and the seats, the floor, cushions and side walls were well sprinkled. Before two-thirds of the church was sprinkled, the men had to leave. They could not remain longer. The church was closed over night, and aired and cleaned next day. Of course, I do not know that it was ideally disinfected.

Professor Franklin C. Robinson, of Brunswick, Maine.—I have given considerable attention to the subject of disinfection, and this discussion brings out one point very prominently, not only in connection with formaldehyde, but many other disinfectants that are being introduced, namely, the necessity and importance of agreeing upon some uniform method for testing them. There is a great variety of methods, and our results largely depend upon the particular method used. I hope the Committee on Disinfection will formulate in the coming year some standard method of testing various disinfectants.

I would add one thing to what has been said. You will remember that I called attention last year to the difficulty of disinfecting on coverglasses. It is one of the hardest tests of a disinfectant. Glass does not ordinarily get infected in a house, yet we know glazed surfaces, or varnished surfaces, are quite similar to glass, and we ought to know what will disinfect under the hardest conditions. I think the question of disinfection with formaldehyde simmers itself down to the fact of getting enough of it. When we get enough of it, I have no doubt the bacteria are killed.

Dr. Frank Warner, of Columbus, Ohio.—I have paid some attention to the subject of disinfection of railway cars in connection with the Ohio State Board of Health. This Board had the matter up some little time ago, and I was appointed Chairman of a committee to look into the advisability of requiring disinfection of railway and street cars operating in the State of Ohio. This investigation was not to be undertaken during epidemics alone, but was to be a constant feature of the cleaning and disinfecting process to be instituted, if not during the entire time of the year, at least during certain portions of the year,

more particularly during the winter months; a time when the cars are closed, and infectious and contagious diseases are more liable to spread. I went to one of the chief railway officials, discussed the matter with him, and he said to me that he was perfectly willing to institute any measures that would not add too greatly to their cost and to their cleaning process, and in the next place, that it be done promptly and efficiently without too much detention of the cars in their service. At the outset, in the first experiment, one difficulty presents itself, that is, the time required in producing a sufficient quantity of formaldehyde gas to make the disinfection complete. In the operation of any of the apparatus with which I am acquainted, there is very little, if any, attention paid to the matter of the promptness with which the gas is generated. Unless the gas can be generated promptly, it will prevent it from being used in many of the railway services. While this would do well enough in the case of a car exposed to a smallpox patient, yet in the case of the cars carrying the ordinary traveler it has got to be done with great rapidity; it must not detain cars any great length of time in the yards. As I say, there is no form of apparatus, with which I am acquainted, that will generate gas fast enough to disinfect the cars and let them out of the yard promptly. It would require a larger number of cars than we now have for them to be detained out of service on account of disinfection.

Then, another problem presents itself in the disinfection of cars. For ordinary disinfection it is necessary to use a quantity of formaldehyde sufficient to destroy all kinds of germs. In thinking over this matter, it seems to me there would be little reason to use an amount of the gas sufficient to destroy all germs; on the contrary, we should use a quantity, which will have to be decided by experiments, which will destroy the germs which we ordinarily encounter in a railway coach or Pullman car.

Mr. Horton, our bacteriologist, is here to-day. He made an experiment along this line for me. We are ready to welcome any suggestions, and in closing the discussion I hope Dr. Johnston will say something in regard to the importance of rapidity in the production of the gas. Then, in the next place, to use it in the smallest quantity compatible with efficient work for the class of cases which we encounter most in the cars operating in this country.

Even with a rapid generation of the gas, there is still another problem that would limit the disinfection either to actually needed times or to occasional, though not very frequent, intervals. The cost would mount up to too much if we attempted to disinfect cars after each trip. Especially would this be true if we attempted more than a surface dis-

infection. Of course, some such plan could be adopted, with thorough disinfection at such intervals as practicable.

Mr. Crosby Gray, of Pittsburg, Pa.—I wish to inquire of Dr. Johnston, as well as of the other gentlemen who are practical disinfectors, what success they have had in the use of formaldehyde during cold weather, or seasons of low temperature.

Dr. Hibbert W. Hill, of Boston, Mass.—I wish to refer briefly to one or two points, and among them, I understood one of the gentlemen to say that he had had poor success with the Schering pastilles. In justice to Schering, I must refer to experiments of our own, in which we compared the pastilles with the formalin solution used in the Sanitary Construction Company's lamp, which is, with us, the standard method of disinfection. We conducted our experiments in two ways. In the first place, we took such quantities of the formalin and of the pastilles as would cost the same and compared them. We used enough of the formalin solution to obtain thorough disinfection; but the number of pastilles which could be obtained for the same price would not disinfect so thoroughly. We could not rely on them. We then made some experiments in another way. We used a certain quantity of gas obtained from the formalin and compared it with the same quantity obtained from the pastilles, the quantity of formalin being that which we had used previously and which we knew would be successful. We found in that case that both the solution and pastilles worked equally as well; it was merely a question of getting sufficient gas, and the pastilles could be made to act efficiently, but at too high a cost for municipal work on a large scale. For smaller private work, where the amount of cash paid for them is not of so much moment, the pastilles in sufficient number are very excellent. Dr. Brougn of the Boston Health Department conducted these experiments.

I wish to say also a word or two about the use of glass, as a carrier for bacteria in disinfection tests referred to by Professor Robinson. At a previous meeting of the Association I suggested a method for the use of glass rods, and I would emphasize the remarks of Professor Robinson as to the necessity of using disinfectants in such quantities that they will kill the ordinary disease organisms when they are in the condition least vulnerable rather than in their most vulnerable condition. In the same connection I desire to refer to one other point brought out as to tests made for killing organisms which are very persistent, such as anthrax. It is of far more practical value to know what will kill typhoid fever and diphtheria germs when they are covered up by a protecting albuminous coat, we will say, or, in other words, are not readily reached by the gas, than to determine what amount of dis-

infection will kill anthrax spores when they are exposed in a perfectly free manner to the gas. From a scientific standpoint it is well to determine the amount of gas necessary to kill very resistant as well as the amounts necessary for less resistant organisms. Since, however, the less resistant ones are those which are encountered principally in ordinary disinfection, it would be financially foolish to recommend for such ordinary disinfection the amounts necessary to kill the more resistant pathogenic forms, the latter being encountered at such extremely rare intervals. When such forms are encountered in practice, we may turn very gratefully to the work of those who have experimented with the more resistant forms, and use the amounts they prescribe.

Mr. E. G. Horton, of Columbus, Ohio.—A few years ago, in teaching dental students in the University of Pennsylvania, I conducted some experiments in reference to the disinfection of the tools used in dentistry, working on the plan of disinfecting them by means of paraform pastilles in a closed chamber. I made several tests, using pure cultures, and also some germs which were taken from pathological conditions found in the mouth. I found that if we used enough paraform pastilles disinfection did occur. I agree with several of the gentlemen who have spoken that we are not going to get thorough disinfection unless we use enough gas. In the disinfection experiments spoken of by Dr. Warner, which were carried on at Columbus, recently, the manipulation of the generator was not at all satisfactory. It was run by an expert, one of the commercial men, and the gas was given off slowly, but not continuously. I did not consider the experiment at all satisfactory; but the point was brought out that we must have a certain amount of gas, generated quickly, in order to get satisfactory results.

Dr. Henry B. Horlbeck, of Charleston, S. C.—In the city of Charleston we have been using Schering's formalin pastilles, and there is not a single case of diphtheria or scarlet fever where there has been a recurrence. As has been demonstrated by the experiments made by Dr. Doty and Dr. Wyatt Johnston, these pastilles are always certain in their results. The great trouble is with reference to minimizing the number of pastilles. If we use a large number, say two or three hundred at a time, in an ordinary-sized room, it ought to be sufficient. There ought not to be any difficulty whatever in evolving the gas rapidly, so that the disinfector can leave the room at once. It strikes me that, on account of its simplicity, this method commends itself. In a community of intelligent, experienced people, with well appointed arrangements, I have no doubt some of the other apparatus might do better, but for the ordinary persons you pick up to do your work, and where you have to trust to them, I think this simple method is the

one to use. Our experience has been favorable. In reference to those infectious diseases where we need to be sure of thorough disinfection of the hangings and textiles about the premises, we use steam disinfection, 230° F. We are encouraged to continue the use of the formalin pastilles for the rooms or apartments until we know positively that we can do better and get more favorable results by other methods.

Dr. Samuel H. Durgin, of Boston, Mass.—As the result of a large number of experiments which we have made in dwellings, where practical work is done, we find that the amount of gas as generally recommended, is only about one-third enough. We are disengaging this gas from the saturated solution of formalin and are sending it through the keyhole from the outside and leaving the room closed for five hours. We find it necessary to evolve the gas very rapidly, on account of the leaky condition of the rooms, even after tightening them up as well as we can by placing strips over the cracks. In the laboratory, or in special work, conducted on a small scale, one-third the amount of gas may be sufficient to kill the micro-organisms. The bacilli used in our experiments have been those of typhoid fever and diphtheria. The least amount which we find to be effective in this work is twenty ounces of the saturated solution of formalin to each thousand cubic feet of air space. In very large rooms, like school rooms where we have large spaces to fill with the gas, we wipe off the desks, chairs, wainscoting, and other surfaces, which may have been infected by the children, instead of wasting gas in filling the room.

Dr. F. F. Wesbrook, of Minneapolis, Minn.—I should like to ask Dr. Johnston some questions. First, I desire to know how much formalin per thousand cubic feet of space he uses where he employs the so-called differential method of applying formaldehyde to materials, such as bedding, etc., underneath the tarpaulin. Second, how the penetration tests were made. He spoke of securing the desired amount of penetration, and I wish to know how these penetration experiments were conducted.

One matter of interest to us in the laboratory of the Minnesota State Board of Health is that which illustrates the varying results obtained by different persons, and would seem to point out the necessity for being careful in drawing conclusions. Dr. George A. Gray conducted a series of experiments in order to determine the relative values of different forms of apparatus. The experiments were begun immediately after the discussion on formalin disinfection at the meeting of this Association held two years ago in Philadelphia. Dr. Gray had similar experiences to those reported at this meeting when he first began, that is, he did not succeed in getting any uniformity of results. It was the

exception to kill any of the bacteria used for test, which were bacillus prodigiosus, bacillus diphtheriæ and bacillus anthracis. These were exposed upon silk, wool and cotton threads, upon pieces of woolen cloth soaked in cultures and upon coverslips. The test threads and cloths were exposed in both a moist condition and after thorough drying.

In every case more than the quantity of formaldehyde specified by the manufacturers as necessary was used, and in many cases two or three times this amount.

Rearrangement of the laboratory necessitated the continuation of the experiments elsewhere. In the next series conducted in another room of approximately the same size, positive results were obtained. All forms of apparatus were effective where the gas was not required to penetrate more than one or two layers of outing flannel before coming in contact with the microbes used for test.

The reason for these differences in results may have been due to difference in the nature of the walls of the rooms.

The room, in which the gas failed to kill the bacteria, was situated in the basement of the building and had thick walls of brick and stone coated with rough porous plaster. On the other hand, in the room in which good results were obtained, the walls were originally of hard, white finish. This was coated over with several layers of black paint. The room is a photographic dark room.

In both rooms the methods were identical and the test objects were placed at various levels in the rooms. The tightness of the windows, doors, etc., was the same and neither room was provided with ventilators. Experiments are now in progress to determine the effect of placing shallow trays of broken rough plaster such as that in the walls of the basement room, in the painted room during the experiments, to see if this will influence the power of the gas to kill exposed bacteria.

I should like to ask Dr. Hurty why glycerine was used as a constituent of the solution employed for spraying the seats, hangings, etc., of cars. Also, if he, or any of the members present have any experience as to whether moisture in the room operates so as to affect results.

In our experience, the test objects which were most easily affected were threads or bits of cloth, which after being dipped in emulsions of pure cultures were exposed to the gas as they were without preliminary drying.

As to the rate of generation of the gas, the size of the room is perhaps not always considered. The efficiency of a generator for a room of a given size should be determined and in larger rooms, instead of using such generator for a longer time, two or more generators should

be used so as to permit of the sudden liberation of a large volume of the gas.

It would seem preferable to have these generators so situated as to allow the gas to enter the room from different points.

Dr. Johnston (closing the discussion).—I shall endeavor, in summing up, to cover the main points which have been brought out. In the first place, out of two hundred disinfections there were only three recurrences, and in each case there was a probability of these being due to something else than the disinfection. In the discussion, I have not heard any member say that he had used it with unsatisfactory practical results. The consensus of opinion of the meeting is evident that formaldehyde disinfection has been effective as regards the prevention of disease, as we have heard nothing unfavorable in the shape of recurrences. By using large amounts of gas we are all agreed that we can get good results from formaldehyde. The next point is the quantity of gas used. Some mentioned the use of twenty ounces or more. I found the use of alcohol involved increase of expense. By the differential method of local concentration the amount of gas used does not exceed one-half a pound per thousand cubic feet, and this does not materially exceed in cost sulphur disinfection.

Reports show that the methods are so divergent as to make comparison difficult. It would be well if we could harmonize them through our Committee on Disinfection, not only by devising a method, but also by a form of recording results so that all of us could use the same tests. If the results of various boards of health could be tabulated, and discussed at a subsequent meeting of the Association, it would give us very important information.

As to the use of glycerine, I have no experience personally.

With regard to the various apparatus used, more depends upon the manner in which they are used than upon their construction, but to get good results by any method it must be properly carried out. One thing was noted, that a saturated formaldehyde atmosphere was found not to disinfect hair brushes, even if they were left exposed to the gas a considerable time, probably because there is a slight amount of grease, etc., on the bristles.

On motion, the Association adjourned until 8 P. M.

First Day—Evening Session.

The Association reassembled at 8 P. M., and was called to order by the Chairman of the Local Committee of Arrangements, Dr. Beard.

Prayer was offered by the Rev. Henry M. Simmons, pastor of the First Unitarian Church, after which Dr. Beard introduced Dr. Samuel

G. Smith, of St. Paul, who, in the absence of the Governor, delivered an Address of Welcome on behalf of the State. Honorable James Gray, Mayor, delivered an Address of Welcome on behalf of the city of Minneapolis. Dr. H. B. Sweetser, President of the Hennepin County Medical Society, welcomed the Association on behalf of the medical profession. Honorable Cyrus Northrop, President of the University of Minnesota, also delivered an address, after which the Vice-President, Dr. Monjarás, took the chair, and the President, Dr. Henry Mitchell, of Asbury Park, New Jersey, delivered the Annual Address. He selected for his subject "A Review of the Sanitary Progress During the Year." (See pages 1-23.)

On motion, the Association then adjourned until 10 A. M., Wednesday.

Second Day—Morning Session.

The Association met at 10 A. M., and was called to order by the President.

Announcements were made by Dr. Beard, Chairman of the Local Committee of Arrangements.

The President.—The next thing in order is the "Report of the Committee on the Cause and Prevention of Infectious Diseases," which will be presented by the Chairman, Dr. Peter H. Bryce, of Toronto, Canada. (See page 85.)

Dr. Frank W. Wright, of New Haven, read a paper on "The Prevention of Contagious Diseases." (See page 96.)

Dr. Jésus E. Monjarás, of San Luis Potosi, Mexico, followed with a paper on "Transmissible Diseases in San Luis Potosi, and Some General Remarks on Their Etiology and Prophylaxis." (See page 102.)

Discussion on the papers of Drs. Bryce, Wright and Monjarás.

Dr. Charles A. Lindsley, of New Haven, Conn.—The paper on "The Prevention of Contagious Diseases" gave us a very clear exposition of the difficulties which a health officer has to contend with in controlling epidemics of contagious diseases. We all recognize the importance of isolation and disinfection, and as aids to that, the necessity of prompt notification of contagious diseases. I only wish to call attention to one remark which may have conveyed an erroneous impression. The Doctor said that there was great difficulty in enforcing the law in regard to the notification of diseases in Connecticut. I merely wish to state in this connection, and I think he will agree with me, that that difficulty has in a great measure now been removed as compared with what it was formerly. I speak with authority, because

as Superintendent of Vital Statistics of the State, I know that I am receiving every month, from almost every town in the State, reports of contagious diseases in existence during the previous month. An average of not more than two or three towns in all the State will fail. I supply the health officers of the towns with postal cards on which is printed a list of the contagious diseases which are to be reported to him by the physicians who have the cases in charge. I know that there have been two or three epidemics of typhoid fever and other infectious diseases which were greatly aggravated by the neglect or the refusal of physicians to inform the health officer of the fact of their presence; the plea being at that time that they did not recognize the disease and were unable to make a diagnosis. When it became known that the epidemic had increased in their respective towns, in consequence of their inability to make the diagnosis, it reflected so much on their professional attainments that it prevented any further trouble on their part, and they incurred the risk of being fined for not reporting these cases, as well as suffering the annoyance of being called incompetent. It is only recently that we have been able in Connecticut to get the reports so faithfully from the local health officers and from the physicians to them. It is in consequence of this fact that when health officers were the only means of enforcing the law, the lawyers and prosecuting attorneys of the town did not pay much attention to it. Matters were neglected. They said that it was doubtful whether sufficient proof could be furnished or not, and on this ground they refused to prosecute. But by recent statute in Connecticut, it is made the duty of one officer in every county to enforce the sanitary laws of that county, and that officer must be an attorney-at-law, and the matter is different when the attorney makes application for prosecution than when it is presented by a health officer who is not familiar with law. If we can secure service by law, making it the duty of an attorney-at-law to enforce sanitary regulations, we are doing a good deal more than a health officer, who is not a lawyer, can do. The notification of contagious diseases in Connecticut is very thoroughly carried out at the present time; I do not say it is perfectly carried out, but it is constantly improving, and the county officers receive notices from my office every month of health officers who have neglected to make their report, and those health officers are called to account for not doing it. They are obliged to report any cases of contagious diseases that are reported to them in their town, and we publish that fact in our bulletin every month. These are practical matters, and are of as much interest as those which are sometimes only theoretical.

Dr. Charles V. Chapin, of Providence, R. I.—I suppose that health officers are not more prone than others to talk about their suc-

cesses instead of their failures. It is rather unusual to have them set forth as explicitly as did Dr. Wright the difficulties which they meet with in their administrative duties. But we often learn far more from our failures than we do from our successes, and I am sure the health officer who appreciates the limitations of his work, and who does not attempt to do more than public sentiment will back up, will accomplish the most for his community. The citizens of New Haven are fortunate in their selection of a health officer. It seems to me, that by far the most important work of a local sanitary organization is the direct control of communicable diseases. It is true, the collection and disposal of refuse, attention to plumbing and ventilation, and the control of adulteration of milk and other foods are important, but altogether they are not quite as important as is the work done in restricting the spread of those diseases which we have with us always—tuberculosis, scarlet fever, diphtheria, measles, whooping-cough, and the prevention of those other diseases which we are liable to have, as yellow fever, cholera, and leprosy.

If any of you should study municipal and State laws, as I have had occasion to do recently, you would see that if in the cities and States, that have laws in regard to the notification of contagious diseases, their isolation and disinfection, these laws were enforced, these diseases ought to be very nearly exterminated. But they are not. They are with us constantly everywhere, and although there has been some diminution among the more common of these diseases in recent years, it has not been very great. What are the reasons why we have not been more successful in preventing the spread of the common communicable diseases? Dr. Wright has touched upon some of these difficulties. The difficulty in regard to the enforcement of the law legally is a question of great importance, but I feel it is not nearly so important as some other matters that were dwelt upon. Dr. Wright has spoken of the hearty cooperation which is given by the majority of the medical profession in this work. Most practicing physicians do undoubtedly, even though at a considerable sacrifice, heartily cooperate with health officers in enforcing the necessary regulations, but a quite large minority do not sympathize with the action which is attempted by the health officer. They do not report contagious diseases; they do not take advantage of the best methods of diagnosis; they do not recognize the cases, and they tell their clients that the work done by the health officer is unreasonable and unnecessary. It is this minority which is our greatest obstacle; it is the teaching of this minority which I believe does the most to hinder proper sanitary work in this direction. I feel that this most important work of the health department in the prevention of contagious diseases is liable to find in the near future

its greatest enemy in the apathy of the minority of practicing physicians. I believe this apathy is not due to wilfulness, but rather to ignorance. I was impressed with the remarks of Professor Welch regarding the development of our knowledge and teaching in regard to the study of the infectious diseases. Professor Welch in his remarks showed how the municipal laboratory has arisen before the teaching laboratory, and how our municipalities have taken advantage of the latest discoveries in science and have attempted to apply them in the practical suppression of communicable diseases. They are ahead of a large proportion of the medical profession; they are ahead because the universities and professional schools have been behind them in adopting modern methods. The universities have been behind hand in introducing laboratory methods and scientific methods of teaching hygiene, and I believe the greatest need at the present time is thorough instruction in modern scientific hygiene by our universities and medical schools.

Dr. Wyatt Johnston, of Montreal, P. Q.—There are none who sympathize more and feel more keenly the importance of what the last speaker has said than teachers of hygiene in universities. The difficulty in teaching hygiene is that the time allotted to it in the ordinary medical student's curriculum does not permit us to qualify him for the special duties of a hygienic official. The direction in which a move should be made would be for our universities to establish diploma courses in hygiene. I think perhaps the Association would be in a position to deal with the matter more thoroughly if a committee were appointed to interest the medical regents, teachers of hygiene, college presidents, as well as members of health boards, so that as soon as universities could give advanced diploma courses in hygiene, the boards of health might see that only those holding diplomas should hold sanitary positions. The first step, however, consists in properly training men for this work. When they are so trained, there will be no difficulty for them to secure positions.

Dr. Charles O. Probst, of Columbus, Ohio.—The Association adopted, I believe, at its last meeting, a resolution with regard to the teaching of hygiene in universities, and I thought I was making good use of the resolution in bringing it to the attention of the officers of our State University at Columbus. The faculty and trustees took hold of the matter with interest. We organized a course of sanitary instruction for health officers, which was to continue for six weeks, with six or seven teachers. We sent out thousands of circulars to boards of health, and one to every health officer in the State of Ohio, inviting them to attend this course and pointing out the advantages which

would accrue to them, such as a probable increase in remuneration for their services, etc. We had expected at least a small class. On the day the school was to open, no communications had been received. There was a meeting of the faculty, but no students were there. So I think, that while we want to interest universities in offering something of this kind, we have got to do something towards interesting men to enter universities to get such a course. We must recognize in this matter the law of supply and demand.

Dr. Benjamin Lee, of Philadelphia, Pa.—I will state, in connection with the question of teaching hygiene in universities, that the Legislature of Pennsylvania at its session last winter passed a law authorizing the various institutions of learning in the State to confer the degree of "Doctor of Sanitation," or "Public Health," or something similar, the idea being that if the promise was held out to students that they could not only receive a course of instruction in sanitation and hygiene, but that at the end of the course they could have something to show for it in the shape of a diploma, it would be an inducement to them to take up the study. The time is coming when the position of health officer, even in rural districts or in townships, will have such an emolument connected with it as to make it desirable. When that time comes such men will naturally be sought for those positions as can give evidence that they have had proper instruction. If all of the colleges in the country would not only give instruction in hygiene, but also provide something in the way of a degree which would crown the work and thus offer an inducement, it would greatly facilitate the object we have in view of elevating the grade of sanitary administration.

With regard to the report of the committee, which was first read. There are one or two points to which I would like to refer in that most interesting and valuable report. The report states, first, that in the recent and present epidemic of smallpox in the United States, the mortality has been placed at the low figure of 5 per cent. I would like to say that in Pennsylvania it has been only about 1 per cent. In more than a thousand cases we have had but ten or eleven deaths. Secondly, the report assigns the cause for this unusually low mortality in a disease usually so terribly fatal to the fact of some unusual characteristic in the virus, and possibly also to the fact that our modes of living have so altered as to diminish the conditions under which the disease becomes fatal. So far as Pennsylvania is concerned, I am quite confident that there has been no such change in the conditions of life, and I can attribute it only to the fact that this peculiar strain, as we may call it, of smallpox virus, the infection from which can be distinctly traced from Cuba to Florida and thence upward, gradually progressing through every seaboard State of the United States, may be

an exceptional variety. It is quite reasonable to suppose that the effect of a tropical climate, through long generations, since the disease was first introduced into the West Indies, may have produced a strain of virus which is exceptionally mild. I do not see any other way in which we can account for it. It has been suggested that the results of vaccination are showing themselves now not only in individuals, but in the race; that the vaccination of parents has produced a certain immunity in children, and, so to speak, a varioloid among all persons who are attacked, the immunity having been transmitted from father to son. Of course, that is mere theory, but however we may explain it we cannot get away from the fact that we have been having such a variety of smallpox as has been entirely unknown to us in the past.

Dr. William Bailey, of Louisville, Ky.—I beg leave to make a remark in the same connection spoken of by Dr. Lee, and desire to say that the history as to mortality from smallpox in Kentucky this year has not been greater than from one to one and a half per cent. In regard to the feature of mildness that characterizes the present epidemic, for one I am ready to confess that I do not understand it and cannot explain it. I do not even undertake to do it. Other diseases have the same characteristic in recent years. Scarlet fever has been so mild that we scarcely regard it with the importance that we formerly did, so much so that people are inclined to subject their children to the disease in order to give them immunity. However, the disease next year, or the following year, may be accompanied by its former fatality. This is not a new thought.

I may say with reference to smallpox and its slight mortality, even in the days of Jenner, epidemics of the disease were so mild that the people disregarded it. That is a part of the history of smallpox, and since that time we have had fatalities sufficiently numerous to satisfy any of us, and it may be that we will not be any longer benefited by the mild character of this disease, but that next year smallpox may again be accompanied by its usual degree of mortality. For one, I see no explanation for it.

Dr. H. M. Bracken, of Minneapolis, Minn.—In connection with what has been said, I would like to say a word or two regarding the mildness of smallpox, and the possibility of its being due to the fact that it was imported from Cuba. We have had more or less smallpox in the Northwest which has been mild. We cannot trace its origin to Cuba or any other tropical climate. I believe we shall have to look for other causes than a tropical climate for the mildness of the present epidemics of this disease throughout the United States.

Dr. Samuel H. Durgin, of Boston, Mass.—I wish that the benign atmosphere of Kentucky would sweep up over New England, so that we might get some relief from infectious diseases. It is a mortification to every health officer to find so many cases of diphtheria, scarlet fever, and of other common infectious diseases in our cities. We have good laws upon our statute books, and energetic officers like Dr. Lindsley, Dr. Chapin and others, but we still have a very mortifying amount of infectious diseases in our midst. In Massachusetts our laws are perhaps as good as those in most of the States, and they provide penalties. If a physician or householder does not report these infectious diseases, they are subject to a fine by the court to the extent of a hundred dollars. We also have a law in our State which gives the local board the right to remove these cases to a hospital, even by force if necessary.

Dr. Peter H. Bryce.—Will you kindly tell us something as to how you proceed in your public schools when there is infection.

Dr. Durgin (resuming).—As one of the auxiliary methods in finding cases of contagious disease early, we have forty-nine physicians in as many districts of the city. The physician goes to his schools each morning; he may have three or four or possibly five school houses to visit, and he sees all children who appear to be ill. We have about eighty thousand school-children in our city. If he finds any contagious disease, he takes particular note of it, but in all cases he advises the teacher what should be done. No orders are given except in cases of dangerous infectious diseases. We find some cases of scarlet fever, diphtheria and measles in this way.

With regard to isolation, it is one of the most important factors we have in the control of infectious diseases. Early notification and substantial isolation are important and we utilize the school inspectors in this way: We send them a bulletin every morning of all contagious diseases reported for the previous twenty-four hours, and they will visit these cases and report to the Board of Health at once whether or not the cases are sufficiently isolated to be allowed to remain at home. If they report against the isolation, the ambulance goes at once for the patient.

I think it right to maintain that when any patient is not so isolated as to allow everybody else in the house to go about his or her business without endangering the public, that patient should go to the hospital where he will be isolated. No one has a right to so use his own so as to interfere with the liberties of his neighbor.

Dr. J. N. Hurty, of Indianapolis, Ind.—During my experience in the sanitary management of contagious diseases, I have met with two great forces to overcome, one of which has not been mentioned. The

first is the jealousy of business men; the second, the great ignorance on the part of physicians, particularly in our small towns. I will relate an incident in this connection. In Valparaiso, Indiana, a town of twelve thousand inhabitants, there is a large normal school that draws students from all over the United States. They have on an average from two thousand to twenty-two hundred students there all the time. A student from the South brought smallpox to this town, and the disease spread rapidly. In a short time there were sixty cases. A diagnosis of chickenpox was made by local physicians. One case of smallpox was found in a far-away town by myself. I telegraphed to the local health officer that probably some cases of smallpox were in his town, and asked him to investigate the matter. He telegraphed back there was no smallpox there. I sent to Valparaiso two experts who pronounced the cases variola and had a long hard argument before the local physicians would give in and say they had smallpox to deal with. The local physicians were ignorant of the disease, or perhaps, they were influenced by business men, who frequently insist that knowledge of epidemics be suppressed. It is difficult to recognize that in a town of twelve thousand inhabitants, there was not a physician who could diagnose mild smallpox. Such ignorance on the part of physicians is reprehensible. If they purposely did not recognize the disease for business reasons, it is still more reprehensible. The first word that came to the State office when the smallpox experts arrived at Valparaiso, was that "The business men were afraid if it became known the disease was prevalent it would ruin their business." I say if business men are opposed to stopping a fire because they think it will injure business, they do not know the first principles of business, and they should learn what business is. It was not until I told some leading people that the whole town would be quarantined and a cordon thrown around it, so that there would be no coming in or going out. that the city authorities got to work. I now believe that that city and its county are the best protected of any in Indiana for they got to work at last and the whole county was thoroughly vaccinated, and an isolation hospital was established and thorough disinfection practiced. There was not a single death from the disease, although there was quite a large number of cases. I have met opposition from business men in many little towns when it was necessary to fight epidemics. The great cry is, if a declaration of smallpox is made, it will injure business, and they deplore the fact that business has to be interfered with, and because Dr. Smith and Dr. Jones say it is not smallpox, they argue there is a doubt and therefore no action should be taken. Opposition on the part of the medical fraternity, through

failure to correctly diagnose, must be overcome before we can make substantial progress.

Just a word or two in regard to the training of health officers. In our State Industrial University, located at Lafayette, some seven years ago there was established a department of hygiene, and Mr. Burrage, who was associated with the working force of the Massachusetts Board of Health, was put at its head and has remained there ever since. There are from fifteen to twenty students in this department every year, and not a single M. D. has ever entered. They are usually young men, who have taken the pre-medical course. We hope to be able to accomplish somthing by getting physicians to take this course. A law was passed by the last Indiana Legislature which commands that every health officer now appointed for a period of four years and paid according to the population which he serves, shall inform himself in hygiene and sanitary science according to the requirements of the State Board of Health. The State Board of Health of Indiana has not issued any requirements for its health officers concerning this matter. We are studying the question and expect to act very soon.

I have, in view of this intended action, listened with interest to what has been said here with a view to boards taking some action in requiring a certain amount of work or knowledge in hygiene and sanitary science on the part of officers, of whom there are eight hundred and thirty-six in our State.

THE PRESIDENT.—Up to the present time no steps have been taken to obtain the sentiments of this organization with reference to the death of Dr. Rohé, and it seems desirable that a committee should be appointed to draft suitable resolutions and present them to the Association. I shall be pleased to entertain a motion by someone to that effect.

It was moved that a committee be appointed to draw up suitable resolutions in regard to the death of Dr. Rohé. Seconded and carried with a standing vote.

THE PRESIDENT.—The committee will consist of Drs. Benjamin Lee, Charles A. Lindsley, Frederick Montizambert and C. H. Jones.

Dr. Wyatt Johnston, of Montreal, P. Q., offered the following resolution:

Resolved, That a committee be appointed which shall take steps to secure advanced teaching in universities and colleges and the giving of diplomas in hygiene, and the recognition of such diplomas by sanitary authorities. Seconded by Dr. Lee. (Referred to the Executive Committee.)

Dr. Ernest Wende, of Buffalo, N. Y., Chairman, read the "Report of the Committee on the Cause and Prevention of Infant Mortality." (See page 112.)

Dr. A. G. Young, of Augusta, Maine, contributed a paper on "Formaldehyde as a Milk Preservative," which was read by Professor Robinson in the absence of the author. (See page 136.)

Professor José de la L. Gomez, of Mexico City, read a paper entitled "Remarks on Dairies in the Capital City of the Mexican Republic: Their Condition Before the Issue of the Sanitary Code and Their Present Condition." (See page 454.)

Professor H. W. Wiley, of Washington, D. C., contributed a paper on "Food Adulteration in Its Relation to the Public Health," which was read by the Secretary in the absence of the author. (See page 145.)

On motion of Dr. A. Walter Suiter, the discussion on the three previous papers was postponed until the afternoon session, the discussion to be made the first order.

On motion of Dr. Wilkinson, the Association then adjourned until 3 P. M.

Second Day—Afternoon Session.

The Association reassembled at 3 P. M., and was called to order by the President.

The papers of Drs. Wende, Young, Gomez and Wiley were then discussed.

Discussion of the papers of Drs. Wende, Young, Gomez and Wiley.

Dr. J. I. Gibson, of Denison, Iowa.—I had hoped that some of the other members of the Association would discuss these papers in order that I might learn something, not that I desire a chance to say something myself. I believe there is a certain course that this Association should pursue in regard to the adulteration of milk with a chemical preservative of any kind. The Association should also take a stand with regard to the tuberculous cow in the dairy. Every cow, found to be tuberculous by the tuberculin test, properly applied, should be condemned by this Association as a dairy cow. Such action on the part of this body would very materially assist us in the work we have to do in the different States. Men, because of a few dollars invested in cows, will fight the test and the condemnation of their cows. There will probably be a resolution presented on this subject.

Mrs. Ellen H. Richards, of Boston.—I did not have the pleasure of hearing all of these papers, but this Association should put itself on

record as in favor of milk without any preservative. It seems to me, that with our present advance in mechanical methods of cooling, of evaporation, or in some way preserving the milk long enough to have it delivered to the consumer, it is unnecessary that any chemical preservative should be added to it. This seems to be perfectly clear and straightforward, and should receive the sanction of this body.

A paper on "The Transmission of Typhoid by Sewage Polluted Oysters," by Mr. Kenneth Allen, in the absence of the author, was read by title. (See page 154.)

Dr. John L. Leal, of Paterson, N. J., read a paper entitled "An Epidemic of Typhoid Fever Due to an Infected Public Water Supply." (See page 166.)

Dr. H. C. H. Herold, of Newark, N. J., read a paper on "Report of Typhoid Fever in Newark, New Jersey." (See page 172.)

Dr. Gardner T. Swarts, of Providence, R. I., read a "Report of a Four Months' Test of a Mechanical Filter Plant at East Providence, Rhode Island." (See page 177.)

DISCUSSION OF DR. SWARTS' PAPER.

DR. THOMAS J. TURNER, U. S. Navy, of Coldwater, Mich.—I would like to ask Dr. Swarts if, in examining the water he has referred to, he determined the relative amount of the nitrates and nitrites. The nitrites are largely the chemical result of bacterial decomposition.

MR. ROBERT S. WESTON, of Boston, Mass.—We are indebted to Dr. Swarts for having presented this contribution to our knowledge of the work of this new type of filter. There are several questions which I would like to ask him in connection with this work:

FIRST. If he tested his effluents to see whether intestinal bacilli were present or not?

SECOND. Whether he made any test to determine the presence or absence of coagulant in the effluent, that is sulphate of alumina?

THIRD. What method he used to determine the color of the water?

FOURTH. After what periods of incubation he counted the bacteria, —at the end of four days or between the fourth and sixth days? In growing cultures of bacteria at 15 degrees C. approximately, I have found from 35 to 40 per cent increase in the number of bacteria between the fourth and the sixth days, and of course if the applied water after incubating six days was compared with the effluent after incubating four days the bacterial efficiency of the filter would be apparently enhanced.

Dr. Swarts objects to the percentage removal of bacteria as bearing on the efficiency of the filter in the broadest sense, because locally there are some bacteria which grow in the lower portions of the filter and bear but little relation to its bacterial efficiency. I think, however, that bacterial efficiency bears a direct relation to the work that the filter does and also that the numbers of bacteria in the effluent represents the quality of the effluent which will be delivered to the consumer. The underdrains are a part of the filter, and a frequently washed American filter offers little chance in my opinion for the development of underdrain growths.

Some time ago a contract was made with one filter company, who guaranteed to remove 97 per cent. of the bacteria in the applied water when the number exceeded 2,000, but guaranteed the effluent should be of such quality as would not be likely to cause epidemic disease when the total number in the applied water was less than 2,000.

Dr. Gardner T. Swarts, of Providence, R. I.—In reply to the first question asked by Dr. Turner, as to the amount of nitrates and nitrites, I will say that in the applied water there was present a variation of from 0.61 to 0.90 parts in 1,000,000 parts of water for nitrates and from 0.40 to 0.60 parts in the filtered water. There was a small trace only of nitrates on two occasions in both the applied and the filtered water. In reference to the question put by Mr. Weston, as to examinations for intestinal bacilli, no such isolation of bacteria was attempted. The principal object was, as requested by the filter company, to determine the efficiency of the filter quantitatively, in removing bacteria. It has already been determined by other filtration experiments that the pathogenic bacteria which get through the filter are very small as compared with the number of water bacteria.

As to sulphate of alumina in the filtrate, tests were made, but I seldom quote the results, which have been found true by other observers, that there is less alumina to be found in the filtered water than is present in the applied water before the dose of alum is placed in the supply. It sounds improbable and is liable to bring discredit upon the rest of the work done.

The color tests were made with the test solutions composed of platinum cobalt, standardized by comparison with the Nesslerized ammonia solutions.

Methyl orange was the reacting agent used in the alkalinity tests.

Dr. Peter H. Bryce, of Toronto, Canada.—In examining the tables presented by Dr. Swarts, one cannot fail to note the interesting fact of a very small number of bacteria per c. c. during the period these examinations were made in testing the mechanical filter he has de-

scribed. Comparing it with the waters I have observed in some of our rivers in which these mechanical filters are used, it seems to me, the water the doctor had to start with was splendid, as compared with many other waters, so that it is difficult to make a comparison on a percentage basis. In one of our tanks we have had as many as twenty thousand bacteria in a c.c. of unfiltered water. After sedimenting it for four or five days, eighty per cent. of the bacteria will settle before the water is passed through the mechanical filter at all. It has seemed to me, comparing the results with what we call pure water, taken from great lakes several miles out from shore, absolutely free from any known sewage contamination, that Dr. Swarts has given us ideal results. We can conceive of nothing much better. The results are remarkable for this class of work.

A MEMBER.—I would like to ask Dr. Swarts how long it takes to clean the filter he spoke about.

DR. SWARTS.—It takes about the same time to clean it as it does most mechanical filters, namely, about twenty minutes. It required cleaning once in twenty-four hours in this plant.

MR. H. W. CLARK, of Boston, Mass.—I would like to ask Dr. Swarts if any effort was made to obtain a ground water supply, before the subject of filtration was thought of, as it is a gravel region, and it would have been cheaper than filtered water.

DR. SWARTS.—The conditions and prospects for obtaining a satisfactory soft water were so discouraging in the City of Providence that no attempt was made to bore at this point, and, as has been stated, I considered this form of filtration to be the most expedient, prompt and practical way out of it.

DR. RAVOLD.—I would like to ask Dr. Swarts whether any standard of bacterial efficiency has been established by this filter. What was the demand of the city in having it put in?

DR. SWARTS.—The company, I believe, guarantees an efficiency of 98 per cent. removal when the count of the applied water is above a certain number and even 99 per cent. if the count is still held at a certain point. The city asked only for as complete efficiency as possible, and, as stated, 99 per cent. was maintained when one grain of sulphate of alumina was used.

Mr. H. W. Clark, of Boston, Mass., read a paper on "Bacterial Purification of Sewage." (See page 187.)

DISCUSSION ON MR. CLARK'S PAPER.

MR. ALLEN HAZEN, of New York City.—I have been deeply interested in Mr. Clark's paper. The problem he has presented is an educational one. He has educated bacteria to do work much more rapidly than bacteria have ever worked before, and to do things which they have not done before.

The experience of many cities for many years has not weakened but has rather strengthened the old proposition that where the conditions are reasonably favorable, the best method of purifying sewage is to apply it to land. A large part of the great cities of the world are so situated that land treatment can be used. Unfortunately, there are many others so situated that the sewage cannot be treated in this way and other processes have to be resorted to.

Chemical precipitation was introduced many years ago in such cases, and proved of very substantial assistance. The process was unfortunately somewhat expensive, and the purification obtained was much less complete than that secured by filtration through sand or soil. Where the streams receiving chemical precipitation effluents were rapid and not obstructed by dams, as at Canton, Ohio, and at Frankfurt, Germany, the results have been satisfactory. On the other hand, where the streams have not been as well adapted to receiving partially purified effluents serious nuisance has often resulted, and it has been necessary to supplement chemical precipitation with the other processes.

In the last few years an entirely new series of processes has been suggested and introduced, which force the bacteria to do things which they have not previously done, and while these processes are still new, and there are a great many difficulties to be overcome, and while they have not yet been applied on a very large scale, the results have been such as to warrant the suggestion which Mr. Clark has made, that the time is not far distant when these processes will supercede chemical precipitation, because of cheapness, and because greater purity of effluent can be obtained by them.

DR. PETER H. BRYCE, of Toronto, Canada.—I need hardly say how much pleasure it gave me to hear this paper, and without attempting to discuss very many of the excellent points in it, I would ask Mr. Clark a question, knowing that there are many difficulties in answering such a special question. It is this: Taking the ordinary sewage discharged from a house, how long probably in its course, either in the sewers or septic tank, in a general way, would it be desirable to leave it there before discharging upon the oxidizing or coke filter beds?

Mr. H. W. Clark, of Boston.—At Exeter, England, where the only large septic tank is in operation, its capacity is about 53,000 gallons, and the daily flow of sewage is about 32,000 gallons; that is, the sewage remains in that tank about a day and a half under dry weather conditions. The sewage, before entering the tank, is stale; that is, about 70 per cent. of its total organic contents comprises the total organic nitrogen in the form of free ammonia. At Lawrence, sewage is about the same. We allow it to stay from twenty-four to thirty-six hours. With pressure sewage I think that in some cases, while we would get better clarification in a septic tank, because the suspened organic matter is a mere paste, the sewage would have to stay in the tank longer to produce the same action and make it more easily purified at these high rates. With pressure sewage entering the septic tank, after the action once got started and you had accumulated a mass of organic matter, it would do the work in from twenty-four to thirty-six hours, notwithstanding the large amount of dissolved oxygen that would pass in with the fresh sewage daily. The question cannot be answered exactly because it varies with the quality of the sewage entering the septic tank.

Dr. Peter H. Bryce, of Toronto, Canada.—The question comes up in municipal work as to the initial cost of these tanks, and in my work in the Province of Ontario I have this feature to contend with. Personally, I have been convinced for many years that the principles involved in the biological purification of sewage are the correct ones, and it is well to urge that system upon all smaller towns which are forced year by year to put in sewage plants. Of course, the problem is how much tankage for a day's sewage, or the fraction of a day's sewage, is necessary in order to enable it to go over into the filter beds of coke to make complete destruction of the sewage. If it can be reduced to a few hours, it is a system which will grow in favor at once. I imagine that the sewage farm idea will be carried out as far as possible where the situation and conditions are favorable, and it is a question as to which is the better plan if we have not a plan where gravity can carry off the sewage.

Dr. Charles V. Chapin, of Providence, R. I., followed with the "Report of the Committee to Examine Into the Existing Municipal Organizations of the Country Belonging to the Association, With a View to Report Upon Those Most Successful in Practical Results." (See page 198.)

Mr. W. H. Allen, of Philadelphia, Pa., read a paper on "Rural Sanitation in England." (See page 210.)

DISCUSSION ON THE PAPERS OF DR. CHAPIN AND MR. ALLEN.

DR. CHARLES A. LINDSLEY, of New Haven, Conn.—It is unfortunate that the last two papers should have been read before such a small audience. There is one important lesson to be observed in contrast between the two papers. I think that the model system which was described in the last paper is not in sight in this country. The author of the other paper evidently bases his results upon a long experience as a health officer in this country, and for the most part I approve entirely of what was said in it, although it does not reach the degree of perfection which we have heard stated prevails in England. There are one or two points in the first paper which I wish to comment on. I do not remember hearing it stated that the health officers were appointed for any length of time. I assume, therefore, it is only for a year. I have noticed a marked difference in my own State in the character and quality and kind of work done by health officers since their appointments have covered a period of four years, as compared with the previous appointments for a single year. Whether this improvement is due to the length of time, or the manner in which they are appointed, I do not know. Doubtless in part to each. Of the evils which afflict boards of health, there is nothing worse than politics. If there is any way of keeping politics out of health administration, it ought to be adopted. We have in some degree reached an excellent method in Connecticut. The appointments of health officers heretofore, for many years past, have always been by popular vote, and every candidate for appointment had to keep the fences up during the year and watch for next year's election. Now, the officers are appointed for four years, but not by popular vote. They are authority in the town which they serve. I am speaking now of town health officers. They are appointed by the county officers of which I spoke this morning. The county officers are not appointed by political influence, but by the Judges of the Superior Court. These county officers are appointed for four years and can at any time be discharged for inefficient service or any other cause. In that way we have entirely eliminated political influences from the appointment of local health officers and give them a length of service which affords them an opportunity to fit themselves for their duties. They take an interest in their work and if they fulfill their duty, they are reappointed.

In regard to the matter of legislation, it has been the law of the State from colonial times, that boards of health in towns shall make sanitary regulations. We have not changed that law. It is now the law that the town health officer is only a single officer in that town. Health boards and health committees are abolished, and there shall also be a single health officer in each city, but appointed by law, not by popular

selection. The town officers are appointed by the county officers, and the city officers are appointed by the Common Council. The town health officers make the sanitary regulations, and up to within a recent period each health officer made such sanitary regulations for his own town as he deemed necessary, without any regard to adjoining towns. But under the new administration, the county officers have with the advice of the State Board of Health as to sanitary points, and with due regard to legal points, drawn up a code of regulations which are in conformity with the state laws and Constitution of the State. On the recommendation of the county officers every town health officer has adopted them and published them in proper form. They thus become the law of each town throughout the State, and thus there is a uniform sanitary code for all towns. There is this peculiarity about our towns: If there is a city or borough within the limits of the township, that city or borough is not under the control of the town officers, but the town officer has control of all territory outside of the city or borough limits. But there is a city health officer, or borough health officer, with a four-year term of office in each city and borough. So that in every organized community the responsibility of sanitary administration is put upon a single person.

Mr. Crosby Gray, of Pittsburg, Pa.—I simply rise for the purpose of correcting an error which, as I recollect, appears in the report of the Committee. It set forth that in Pittsburg, among some other cities mentioned, plumbing inspection was performed by some other department than the Health Department. I desire to say that inspection in plumbing is performed by the Bureau of Health, and has been since 1895, with good results.

I regret that I cannot agree with the Committee regarding the question of plumbing inspection. The Committee recommends that inspection of plumbing and house drainage should be performed by some other department. Personally, I regard the inspection of plumbing and house drainage as being purely and simply a sanitary measure, and therefore should be performed by the health authorities.

Dr. J. I. Gibson, of Denison, Iowa.—I believe the Committee recommended that foods should be under State authority, and the milk supply controlled by local authority. If you bring the local authority in this case down to the local board of health, it is a town or township board. Now, in Iowa, we meet with great difficulty.

Dr. Mitchell.—You are in error in regard to that. I believe the report recommends that the milk supply shall be under the control of sanitary authorities.

Dr. Chapin.—In reading the report I only read the bare conclusions of the Committee. Our report states that the control of the milk supply alone of all foods should be in the hands of the local board. It was our duty in making this report to consider the actual state of things in the United States and what had practically been accomplished, and it was believed by your Committee from a study of the existing circumstances that at present the best control of the milk supply would be obtained by placing it under the local boards of health of cities. The Committee was well aware of the state of affairs in Iowa, and that there has been good work done in that and other States by the Dairy Commissioners. The greatest difficulty with the milk supply seems to have been encountered in municipalities.

Dr. J. I. Gibson, of Denison, Iowa.—I grant that the report of the Committee is correct, provided the local authority is the board of health of some city or town where they realize the importance of the milk supply. I have had some experience which makes me doubt whether or not the milk supply of a township should be under the control of three farmers from that township. I have had presented to me by the board of health of a township in Iowa a petition setting forth five or six reasons (which were very lame in the eyes of sanitarians) why a dairy herd, 80 per cent. of which were found to be tuberculous by the tuberculin test, should be released from quarantine. The local board of health signed this argumentative petition and sent it to the State Board of Health, setting forth the reasons why quarantine should be removed, and claiming that this herd was fit for dairy purposes. The local health officer of the township in signing the petition appended the titles of M. D. and Ph. D. to his name. My view of the matter is that where dollars and cents cut so great a figure as in that township, the milk supply must be controlled and regulated by some board outside, or some trustee or officer who is not dependent upon the good will of the people in that township. I think that the county health officer idea, as set forth by Dr. Lindsley, is very good, and there should be a convention of county health officers so as to obtain uniform regulations. There is only one kind of milk that is fit for use, and that is pure milk from a healthy cow, that receives only pure food and pure water, and it seems to me the State or county regulations should be made uniform so as to apply to all milch cows of any part of the district, county or State.

I was very much gratified in listening to the last paper. I was raised a British subject, and I thought I knew something about sanitation in British domains. I know the idea is prevalent in the home, on the farm, or in the city, that the government does not act as an oppressor, as a destroyer, but as a protector, as a parent. I believe that any

government, State or National, has a right to dictate in a large measure what its people shall eat and drink, and along this line I favor the health regulations that are backed up by authority and plenty of it, as compared with the township I have just mentioned where they sent in a petition to be allowed to use the products of a diseased herd.

Dr. Benjamin Lee.—While this is an admirable paper, I do not think we are prepared to accept it as a finality. I therefore move, first, the continuance of the Committee on Sanitation; second, the reference of this paper of Mr. Allen to it, and, third, that Mr. Allen be added as a member of the Committee. Seconded by Mr. Gray and carried.

Dr. James F. Kennedy offered the following resolution, which was referred to the Executive Committee:

Resolved, That it is the sense of this Association that no chemical agent, such as formaldehyde, preservaline, freezine, or other agent should be used in the preservation of food products, milk, meat, or fruit, and that stringent laws should be enacted to guard against food adulteration.

On motion, the Association adjourned until 10 A. M. Thursday.

Third Day—Morning Session.

The Association met at 10 A. M., and was called to order by the President.

The President.—We will now listen to the report of the Executive Committee, which will be presented by the Secretary.

The Secretary.—The following resolutions have been considered by the Executive Committee, and are reported back to the Association with the recommendation that they be adopted in their amended forms:

Resolved, That this Association believes that the presence of forests is conducive to the preservation of the public health;

Resolved, That this Association recommends to all governments to set apart such portions of their forests as may be practicable for National Parks.

The President.—Are you ready to take action in regard to this resolution?

Dr. Benjamin Lee.—I move its adoption. Seconded and carried.

The Secretary.—The resolution offered by Dr. Johnston has been considered by the Executive Committee, and they recommend it to the Association for adoption.

Dr. Holton.—I move that the resolution be adopted as read. Seconded and carried. (For resolution, see minutes of previous day.)

THE SECRETARY.—The resolution offered by Dr. Kennedy, and signed by Mrs. Richards, Drs. Shrader and Gibson, has been considered by the Executive Committee and is referred back to the Association with the recommendation that it be adopted in its amended form. The resolution reads:

Resolved, That this Association favors the enactment and enforcement of laws to prevent the addition to milk, or other food products, of formaldehyde, preservaline, freezine, or other chemical agents not approved by competent scientific authority.

On motion of Dr. Liston H. Montgomery, the resolution was adopted as read.

THE SECRETARY.—The question has been asked in regard to publishing the papers that are read before this Association in some of the sanitary or medical journals prior to their publication in the Transactions. Under the rules of the Association, it is provided that papers read before this body cannot be published elsewhere until they have appeared in the printed Transactions, but the Executive Committee has recommended that papers read before the Association may be published in medical or sanitary journals (prior to their publication in the Transactions), approved by the Publication Committee.

THE PRESIDENT.—What is your pleasure in regard to this matter, gentlemen?

DR. BRYCE.—I move that the action of the Executive Committee be concurred in. Seconded and carried.

THE SECRETARY.—There is a report from the Executive Committee, which is in the hands of Professor Robinson, who will kindly present it.

PROFESSOR ROBINSON.—This report has to do with the step which has been proposed at this meeting, namely, to organize a section to be known as the "Bacteriological and Chemical Section of the American Public Health Association." The matter has been submitted to the Executive Committee; various conferences have been held in regard to it, and the Executive Committee, through the Committee which it appointed, and which is reported to them, has been accepted, and now refers it to the Association for adoption. The formation of this section will involve an amendment to the Constitution, which, of course, cannot be carried at this meeting, and such amendment will have to lie over for a year. But an amendment to the Constitution will not be presented, if the basis of formation of this section is not agreed to by the Association; but if it is, then an amendment to the Constitution will be presented to the Asssociation. Arguments in favor of the formation of this section would not be appropriate for me to make; I sim-

ply state the fact, that the matter has been approved by a sub-committee of the Executive Committee, and by the whole Committee afterwards.

Professor Robinson then read the following:

Report of a Committee, appointed by the Laboratory Committee of the Association, to formulate rules for the organization of a section for the consideration of bio-chemical topics.

NAME OF SECTION.

This section shall be known as the Bacteriological and Chemical Section of the American Public Health Association.

MEMBERSHIP.

Persons personally engaged in bacteriological or chemical laboratory work, and who are members in good standing, of the American Public Health Association, are eligible to membership in this section.

APPLICATION FOR MEMBERSHIP.

Applications for membership shall be endorsed by three members of the section; shall be approved by a two-thirds vote of the Section Committee present at the meeting, and applicants shall be elected to membership by a majority vote of the members present at any regular meeting.

OFFICERS.

The officers of the section shall consist of a Chairman, a Vice-Chairman, a Secretary and a Local Secretary, to be nominated by the section, and transmitted to the Association for election as in case of its other officers.

COMPOSITION OF SECTION COMMITTEE.

The Section Committee shall consist of the officers of the section and four additional members of the section to be elected by the section, and the retiring Chairman, ex-officio.

DUTIES OF THE SECTION COMMITTEE.

The duties of the Section Committee shall be to prepare a program for each meeting in cooperation with the General Secretary of the Association; to supervise the publication of the proceedings of the section; to obtain reports from special committees of the section, and to attend to all other business not otherwise provided for.

TIME OF MEETINGS.

Meetings shall be held on the first day of the meeting of the Association, and at such other times as may be decided upon, but no meet-

ing shall be held during the time occupied by the meetings of the Association.

You will notice from what has been read to you, that the first day of the meeting of the Association is to be occupied by the meetings of this section. The Executive Committee recommends, in connection with that, that a further vote be passed by this meeting, because the general Association fixes the time of meeting, etc. It is recommended that the Association begin its meeting next year on Monday, and that the whole of that day be devoted to the meeting of the section and committees and presided over by their various chairmen. This would add one day to the meeting, the first day being devoted, not to any meeting of the general Association, but to the meeting of this section and whatever other committees of the Association may call a meeting at that time. Of course, if this matter is adopted, there is a possibility of other sections being formed in the near future, and they would have one day clear, with the possibility of arranging for other time without interfering with the meetings of the general body. As I have previously remarked, it is necessary also to change the Constitution, which does not provide for the formation of sections, and the proposed changes are these:

PROPOSED AMENDMENTS TO THE CONSTITUTION.

To Article IV. After the word Treasurer, add "and the officers of the various sections."

To Article IX. After the word Treasurer, add "and Chairmen of the various sections."

Add as new article the following:

Article XVII. Members of the Association may be authorized to form themselves into sections by vote of the Association at any annual meeting; such sections shall have power to nominate their officers to be elected by the Association, and to make by-laws which shall go into effect when approved by the Association.

As it is evident the amendments to the Constitution will not go into effect until next year, it is necessary for the Association to approve of the temporary organization of this section until the Constitution is properly amended authorizing the permanent formation, so that the section can elect officers this year and proceed with their work regularly. The Executive Committee submits this report with its unanimous recommendation.

Dr. William Bailey.—I move that the report be adopted as a whole. Seconded and carried.

THE PRESIDENT.—The next thing in order is the report of the Treasurer, by Dr. Henry D. Holton.

Dr. Holton presented the following report:

TREASURER'S REPORT.

HENRY D. HOLTON, TREASURER, IN ACCOUNT WITH AMERICAN PUBLIC HEALTH ASSOCIATION.

1898.		Dr.
September 21	To cash on hand	$1223 03
	To cash from Transactions sold	217 20
	To cash from advertisements	90 00
	To cash from dues of members, 1898	1610 00
	To cash from dues of members for other years	170 00
		$3310 23

1898.	*Disbursements.*	Cr.
October 15	By cash paid on order No. 79, C. A. Lindsley, printing, postage and telegrams	$ 9 51
October 20	By cash paid on order No. 80, Henry D. Holton, expenses, Ottawa meeting	41 78
October 20	By cash paid on order No. 81, C. O. Probst, expenses, Ottawa meeting	70 55
November 8	By cash paid on order No. 82, Wm. Whitford for reporting Ottawa meeting	153 40
1899.		
January 11	By cash paid on order No. 83, Rumford Printing Co., for printing	304 70
January 12	By cash paid on order No. 61, Henry Mitchell, for printing	28 75
May 3	By cash paid on order No. 84, Rumford Printing Co., for printing	337 21
May 3	By cash paid on order No. 85, Cressy L. Wilbur, for printing and postage	54 50
May 4	By cash paid on order No. 86, Berlin Printing Co., for printing	1047 53
June 16	By cash paid on order No. 87, C. O. Probst, for copyright and postage	31 50
June 16	By cash paid on order No. 88, American Express Co., for transportation	29 45
June 16	By cash paid on order No. 89, United States Express Co., for transportation	17 46
June 16	By cash paid on order No. 90, Adams Express Co., for transportation	23 42
June 16	By cash paid on order No. 91, Wells, Fargo & Co. Express, transportation	2 64
October 6	By cash paid on order No. 92, C. O. Probst, services as Secretary	250 00
October 14	By cash paid on order No. 93, Henry D. Holton, for office expenses, storage Transactions	179 35
March 3	By cash paid on order No. —, W. O. Davis & Co., for books.	4 50
October 20	By cash on hand*	723 98
		$3310 23

*This includes balance of index unexpended of $493.48.

The Auditing Committee begs leave respectfully to report that it has examined the report of Henry D. Holton, Treasurer, and finds it to be correct, and that there is a balance in the treasury of $723.98.

(Signed) BENJAMIN LEE,
U. O. B. WINGATE,
J. N. HURTY,
Auditing Committee.

Minneapolis, Minn., Nov. 2, 1899.

Dr. William Bailey.—I move that the report be received and referred to an Auditing Committee. Seconded and carried.

The President.—The Auditing Committee will consist of Dr. Benjamin Lee, Dr. J. N. Hurty and Dr. U. O. B. Wingate.

The Secretary at this juncture called the role of the Advisory Council for the purpose of filling vacancies.

Dr. William Bailey, of Louisville, Kentucky, read a paper entitled "History of Vaccination." (See page 219.)

Dr. W. C. Woodward, of Washington, D. C,. followed with a paper on "Accidents of Vaccination." (See page 223.)

Dr. Miguel Marquez, of Chihauhau, Mexico, read a paper entitled "A Cause for Unsuccessful Vaccinations." (See page 236.)

DISCUSSION ON THE PAPERS OF DRS. BAILEY, WOODWARD AND MARQUEZ.

Dr. Eduardo Licéaga, of Mexico City, Mexico.—If I understood the statements made by Dr. Bailey correctly, that immunity is not acquired after one successful vaccination, I think it is unfortunate, and I beg leave to disagree with him, inasmuch as in the Federal District of Mexico, where the laws of Jenner are laid down, fully understood and practiced, revaccination is rarely, if ever, needed. In Europe revaccination has become imperative because of the use of animal virus, while in Mexico we use humanized virus. For that reason it is not necessary to revaccinate. I would like to ask Dr. Bailey whether in Kentucky inoculations are made with animal virus or from humanized virus?

Dr. Bailey.—Largely from the animal.

Dr. Licéaga.—Do you revaccinate?

Dr. Bailey.—Yes; in some cases.

Dr. Licéaga.—In Mexico, where Jenner's method is carefully carried out, revaccination is hardly ever necessary.

Dr. Louis V. Cabana, of Fall River, Mass.—During the epidemic of smallpox in Montreal in 1885, a discussion arose between the physicians of the city as to the merits of humanized and animal virus. Nearly all physicians at that time were opposed to the old-fashioned method of taking virus from a child or a grown person for many reasons, unless the history of the family was known. In the first place, there is a possibility of infecting a person so vaccinated with syphilis. Furthermore, other diseases have been introduced into the human body by taking virus from another child. Personally, sterilized virus from

the animal is preferable. I think we had ten thousand cases altogether in Montreal during that epidemic. We used animal virus, but did not see as many bad results as from the old-fashioned method mentioned by Dr. Licéaga.

Dr. Wright, of Minneapolis, Minn., (by invitation.)—I have had a large experience in the treatment of smallpox, as well as with vaccination for its prevention. For six years I lived on the Western coast of the Mediterranean Sea, where smallpox is very prevalent, and the custom there was to vaccinate with humanized virus. I do not recall any case of syphilis or any other disease being communicated from one person to another by that method of vaccination, and I saw thousands of vaccinations performed in that way.

Dr. Samuel W. Abbott, of Boston, Mass.—With reference to the history of vaccination as a preventive measure, President Jefferson vaccinated the members of his family and the slaves of Monticello. This was about August, 1801. A very full report of it will be found in the North Carolina Medical Journal for January, 1881.

There are one or two fallacies I desire to refer to with reference to the origin of cowpox in this and other countries. One is the so-called rare occurrence of cowpox. This statement is an invention of the commercial men who are interested in the production of vaccine. If a case of cowpox occurs these commercial men try to convince us that it is the only case that has ever been recorded. As a matter of fact, this is not true. If you will investigate any agricultural community at a time when smallpox is prevalent, you will find plenty of cases of cowpox. I saw at least twenty in our State within a few miles of my own door in 1872, and again in 1881. I saw many cases of the disease during its prevalence in cows, and tested the animals by vaccinating them afterward. All attempts at vaccination of such animals proved failures.

As to the origin of the disease, it is often said that it originates in the cow. We know very little about the remote or early origin of infectious diseases. If the disease occurs in the cow, it always takes place on the part that is handled by human hands, that is, the udder. The only place where it ever occurs in the horse is in the heels which are handled most by veterinarians. To speak of infectious disease as "spontaneous" or "originating in" certain animals is contrary to reason and observation. One might as well speak of oak trees or hills of corn as "originating" in the soil. There must of necessity be an antecedent acorn or handful of corn.

Dr. Charles F. Roberts, of New York City.—I would like to ask Dr. Licéaga a question. If persons are not susceptible after the method

of vaccination he has mentioned, how often is revaccination practiced, and what are the results?

Dr. Eduardo Licéaga, of Mexico City, Mexico.—In reply to Dr. Roberts' question, I beg leave to say that the experiment has been tried repeatedly of inoculating persons by Jenner's method without obtaining any results.

Professor William H. Welch, of Baltimore, Md.—As a supplement to Dr. Bailey's interesting historical sketch, I should like to call attention to the little known share of Dr. John Crawford in the introduction of vaccination into this country. He received a supply of vaccine virus from London in the summer of 1800, and successfully used it. This was contemporaneous with its use in Massachusetts by Dr. Waterhouse. Dr. Crawford was a prominent physician of Baltimore, Maryland, who anticipated in many respects the modern conception of infectious diseases, and claimed that insects are active in the conveyance of these diseases.

I hope that the sentiment of the association is not in favor of a return to the use of humanized lymph. We cannot question the occurrence of authenticated instances, to be sure most exceptional, of the transmission of syphilis by it. A single instance of the conveyance of such a disease through humanized lymph is enough to bring discredit upon its use, and it furnishes ammunition for the anti-vaccinationists. Even if bovine lymph is somewhat less active, often requiring revaccination, the bare possibility of the conveyance of vaccinal syphilis by humanized virus should lead to the adoption of bovine lymph.

Dr. Woodward's very interesting summary of the various accidents arising from vaccination is certainly timely. The most important of the accidents which he enumerated are unquestionably the septic infections, which may occur at the time of vaccination or subsequently. The infection is in the majority of cases caused by the widespread pyogenic micrococci but occasionally by pathogenic bacilli, including the tetanus bacillus. It is not possible to emphasize too strongly the importance of carying out strict antiseptic precautions. While the operation is a trivial one, in this day of organized campaigns against vaccination, we should not give our fanatical opponents any material for carrying on this agitation. We have now in glycerinized lymph, a material which is free or can be made free from extraneous organisms.

The problem of disinfection of the skin is not a simple one. It is only possible, as has been repeatedly demonstrated, to disinfect the

superficial layers of the skin. There are bacteria, notably the white pyogenic coccus, situated in the deeper layers of the skin, and not to be reached by any known chemical methods of disinfection of the skin. Fortunately, this white pyogenic coccus has very slight virulence, and unless there be very exceptional circumstances as regards susceptibility on part of the patient and the local condition, I do not think there need be much fear as regards the pathogenic invasion of this particular organism. The physician should instruct the patient as regards the danger of infection and employ means of guarding against it.

Dr. Eduardo Licéaga, of Mexico City, Mexico.—Referring to the remarks of Professor Welch, I desire to say that we have a great preference for the method of Jenner. Over thirty years ago experiments were made in Mexico with animal lymph or virus, but the results were not half as satisfactory as those obtained with humanized lymph.

As to the conveyance of infectious diseases by the use of humanized virus, if scrupulous care is observed in the examination of every patient who is vaccinated, this will not occur. Antiseptic and aseptic precautions must be carefully carried out in every case. My statements are based on more than two hundred thousand cases, as noted in the records of the Superior Board of Health of Mexico.

Dr. Peter H. Bryce, of Toronto, Canada.—In view of the statements that have been made by Professor Welch, in which we were all interested, I would like to have him express his opinion in regard to the practicability of hypodermic injections of vaccine.

Professor William H. Welch, of Baltimore, Md.—I am sure there are gentlemen here who have had more practice in vaccination, and who can reply to the inquiry of Dr. Bryce better than myself. I am not at all prepared to express an opinion with reference to adopting hypodermic puncture in vaccinating, because I have not had any experience with this method.

Dr. Charles V. Chapin, of Providence, R. I.—In the report of the New York Board of Health for 1896 there is an interesting account of some experiments in which subcutaneous inoculations of vaccine were made, and these experiments showed that it was not as reliable as inoculation by scarification. The experiments were conducted carefully and the results are decidedly unfavorable to the hypodermic method.

That report also contained another observation which was entirely new to me, and it is this: The cicatrix following vaccination is no indication at all of the character of the vesiculation. I think they followed some two hundred cases of vaccinia for a year or two, and it was found that many of the cases which presented perfectly typical cicatrices had not had particularly good vesicles; while others which had, in the first place, presented typical Jennerian vesicles, had very poor cicatrices.

Dr. Samuel H. Durgin, of Boston.—I recall seeing a young person vaccinated by subcutaneous injection thirty years ago. The constitutional disturbance was exactly like that which follows vaccination by the ordinary method, and after recovery the vaccination was attempted by scarification in the ordinary way, but no result could be obtained, showing that he was substantially vaccinated. There is one disadvantage in this method from its leaving no cicatrix which is sometimes of great use.

Dr. W. C. Woodward, of Washington, D. C.—It may be of interest to members of this Association to know that Dr. Kinyoun vaccinated a number of persons in Washington last spring by the puncture method and obtained satisfactory results. In a recent communication from him he stated that he is using this method at the San Francisco Quarantine Station, where he now is, and the effects are perfectly satisfactory.

Dr. J. N. Hurty, of Indianapolis, Indiana.—In a town in Southern Indiana I had occasion to vaccinate forty-eight negroes not long ago. In these cases the puncture method was used. I have not seen any of the men since, but I left postal cards with the local health officer to inform me concerning them. Subsequently I got reports concerning twelve of the men from the local health officer, who had watched them closely, and he was very certain that in that number a perfect success had been obtained. The puncture was very shallow.

Dr. Frederick Montizambert, of Ottawa, Canada.—There was one point touched upon by Professor Welch which is important and ought not to be overlooked. It cannot be dwelt upon too much, and it concerns the relation of the profession to the public in this matter. While there may be a question raised as to the actual scientific value of the two methods which have been referred to in this discussion, there is no doubt that the use of bovine virus puts us in a better position with our patients, with the anti-vaccinationists, and the general public. When we propose to vaccinate with humanized lymph and are asked

if it be not the case that disease has sometimes followed such vaccination it is difficult, conscientiously, to give an emphatic negative. On the other hand, if we use bovine virus and a similar question of the possible communication of a disease by the use of that virus comes we will be in a much stronger and better position to defend ourselves.

Dr. Charles F. Roberts, of New York City.—I am strongly of the opinion that we should use bovine virus for purposes of vaccination, and to return to humanized virus would be almost criminal, in that it would put us in such a position with the public as has been mentioned by Dr. Montizambert.

With reference to the efficacy of vaccination by humanized virus, I was vaccinated with it when I was a boy about a year old; I still have marks on my arm. I have been revaccinated since my connection with the Board of Health of New York City the last thirty-odd years every two or three years, and it has always taken to a certain extent, and I believe that if I were vaccinated to-morrow there would be a certain amount of action shown by the lymph at the point of contact. I hope the Association will not in any way turn to the support of humanized virus.

Dr. Benjamin Lee, of Philadelphia.—In support of the contention that syphilis may be conveyed by vaccination, I wish to state that we have had an instance in our State in which there was no doubt whatever that several members of one family were infected in that way. In some of them the results were of the most serious character. As indicating the source of danger in this case we discovered that the man who vaccinated these people was a "drummer," not a doctor.

I wish to say also that there seems to be an element of danger of failure in the too free use of antiseptics in vaccinating. I prefer to use no antiseptics, but simply hot sterilized water to prepare the surface before vaccinating. I believe very many of the failures which have been recently noticed have been due to carelessness in the use of antiseptics.

Dr. Josiah F. Kennedy, of Des Moines, Iowa.—The President of the Anti-Vaccination League resides in Iowa, and we are flooded in our State with their literature. They make the declaration that not only syphilis, but tuberculosis, is transmitted by bovine inoculation. I would like to have Dr. Welch furnish us a little information in regard to that point, because these anti-vaccinationists in my State are making all sorts of claims regarding the conveyance of tuberculosis, owing to the prevalence or frequent use of bovine vaccination.

Professor William H. Welch, of Baltimore, Md.—I am sure Dr. Woodward covered that point very well in the few words he uttered. Notwithstanding what has been said, I do not believe there is a single authenticated instance in which tuberculosis has been conveyed by vaccination.

Dr. Louis Laberge, of Montreal, P. Q.—I have had considerable experience in vaccinating with humanized lymph, having had occasion to vaccinate eight thousand cases myself and verified the results in every case. If proper precautions are used, especially in regard to the collection of the lymph not later than the fifth or sixth day, there is no danger whatever in vaccinating with humanized lymph. There is no danger of conveying syphilis, if pure lymph is used and aseptic precautions are taken. With reference to the value of the lymph, there is no doubt but that cases vaccinated with humanized lymph take far more easily and follow a more regular course than they do where bovine virus is used. In my opinion, the regularity of the phases of a case of vaccinia constitute one of the best criteriums of its protective value.

Dr. Liston H. Montgomery, of Chicago, Ill.—I would like to ask Dr. Woodward whether he has ever encountered a case of tetanus following vaccination, and also whether he has examined for the presence of pathogenic germs and pus in the discharges.

Dr. Louis V. Cabana, of Fall River, Mass.—I will say that in the month of September we had two cases of tetanus following vaccination. The public were indignant; we made a careful investigation, and one of the cases was thought to be due to vaccination.

Dr. W. C. Woodward, of Washington, D. C.—In my investigations I found a record of one case of tetanus connected with vaccination. In a letter received from the Superior Board of Health of Porto Rico, where they have recently vaccinated eight hundred thousand people on that island, one death is recorded from tetanus. This is the only case I have found.

Dr. H. M. Bracken, of Minneapolis, Minn.—It would be interesting to know how soon tetanus developed after vaccination was performed. There were two cases of tetanus reported in this State as having followed vaccination, but when the cases were thoroughly investigated the evidence was strongly in favor of the infection having occurred some little time after vaccination, and not at the time of vaccination. In one case, in a dirty family, tetanus occurred a little over three weeks after the vaccination. The other case was a girl who had

a septic arm. No attention was given to the arm until several weeks after vaccination. The infection was evidently secondary in both cases, and the proof is not conclusive in either case that the disease was due to vaccination.

Dr. Louis V. Cabana, of Fall River, Mass.—In the case that came under my observation at Fall River, tetanus developed in the child ten days after vaccination. The child belonged to a clean family, was kept in the house, and never went out.

Dr. William R. Stokes, of Baltimore, Md.—I wish to refer briefly to an experiment performed in Baltimore by Dr. Fulton and myself concerning vaccination being the cause of tetanus. Twenty white rats were inoculated at the root of the tail with glycerinated virus, and it was found that none of the rats developed tetanus. One rat was eaten by another, but the other animals remained perfectly well. We could not isolate any germ resembling tetanus in anaerobic cultures from glycerinated virus.

Dr. Bailey (closing the discussion).—In reply to Dr. Abbott regarding the introduction of vaccination into this country, the limitations of time and length of my paper precluded entering into the interesting questions that were brought up in the discussion.

In reference to the question submitted by Dr. Licéaga, I made the argument that protection by vaccination ought not to be considered better than the immunity afforded by an attack of the disease; or, to put it in another way, we do not hope for a better immunity by vaccination than is afforded by the disease itself.

As to the other remarks of Dr. Licéaga, the Republic of Mexico is exceedingly fortunate if the history of two hundred thousand cases of vaccination he gives there is correct, and I do not doubt his statements. It is really a wonderful history. We have not had such favorable experiences in this country, for the reasons that were brought out this morning, and we are inclined to use virus from the cow rather than humanized virus. By the use of glycerinated lymph and other methods, warding off the dangers of infection from other diseases, we shall look forward to attaining greater perfection in vaccination than we have heretofore.

Dr. Benjamin Lee presented the report of the Auditing Committee, as follows:

REPORT OF THE AUDITING COMMITTEE.

Your Auditing Committee begs leave to respectfully report that it has examined the accounts of the Treasurer, Dr. Henry D. Holton, and has found them to be correct, and that there remains in the treasury a balance of $723.98. (Signed) BENJAMIN LEE,
U. O. B. WINGATE,
J. N. HURTY,
Auditing Committee.

On motion of Dr. Bailey, the report was adopted.

DR. LEE.—I desire to make the following report with reference to resolutions on the death of Dr. Rohé:

REPORT OF A COMMITTEE APPOINTED TO CONSIDER THAT PORTION OF THE PRESIDENT'S ADDRESS WHICH REFERRED TO THE DEATH OF DR. ROHE.

The committee appointed to draft resolutions with reference to the death of Dr. George H. Rohé, begs leave respectfully to offer the following:

Resolved, That the announcement by the President of the Association of the sudden removal by death of Dr. George H. Rohé, while President of this Association, has been received by its members with profound regret;

Resolved, That we recognized in Dr. Rohé not only the accomplished scholar, the versatile author, the sagacious administrator and the well-trained sanitarian, but, as well, the courteous gentleman, the genial companion, and the faithful friend;

Resolved, That in his departure from the sphere of his earthly activities, when his life and his fame were scarcely at their zenith, this Association, in common with the medical profession, with sanitary science and benevolent enterprise, has sustained a great and lasting loss;

Resolved, That these resolutions be prominently placed in our Transactions, and that a copy of the same be transmitted to his family.

(Signed) BENJAMIN LEE,
C. A. LINDSLEY,
F. MONTIZAMBERT,
C. HAMPSON JONES.

On motion of Dr. Lee, a rising vote was taken in confirmation of the resolutions, which was unanimous.

Dr. U. O. B. Wingate, Chairman, Milwaukee, Wisconsin, presented the "Report of the Committee to Define what Constitutes an Epidemic." (See page 241.)

Dr. Hibbert W. Hill, of Boston, Mass., read a paper on "The Official Definition of Diphtheria." (See page 243.)

DISCUSSION ON DR. HILL'S PAPER.

Dr. Louis B. Wilson, of Minneapolis, Minn.—This clear and succinct definition by Dr. Hill, of diphtheria, as related to public health work, should not be allowed to go unnoticed and undiscussed, and it would seem advisable that the Association should adopt some recommendations along the line of his definition. I trust, however, Dr. Hill will pardon me for suggesting certain other factors, even though they may be disturbing elements in the seductively simple definition which he has given us. These are problems which have confronted us in the Minnesota State Board of Health Laboratory, and though much discussed by all of us, still remain, to a large extent, unsolved, and must not be forgotten in formulating a working code of rules for establishment and maintenance of quarantine.

We must not forget that the diphtheria bacillus varies greatly in its morphology; and that while certain morphological types are ordinarily virulent, and certain other morphological types are ordinarily non-virulent, yet in the former group there are occasional cultures with an extremely low degree of virulence, and in the latter group, occasional cultures with a fairly high degree of virulence. We believe also, that there are certain other morphological types of which, at present, we know too little to warrant us in making any statement as to their virulence. Indeed it is probable that there is no characteristic of morphology which is a safe or accurate index of the pathogenesis to animals of any type of the diphtheria bacillus. It is possible, too, that we have not yet perfectly established the hypothesis that unmeasured pathogenesis to guinea pigs is an accurate index of infectiousness to non-resistant human beings. But even if the constancy of such a relationship be considered settled, the isolation of the diphtheriæ bacillus and the determination of its pathogenesis to animals is altogether too slow a process to permit us to use the data for the routine establishment of quarantine, however useful it may be in determining the maintenance of quarantine. We must fall back, then, in the majority of cases for our data for a bacteriological definition of diphtheria for quarantine purposes, on the morphological appearance of cultures direct from the noses or throats of patients whom we examine.

It behooves us, therefore, as Dr. Hill has pointed out, to carefully consider in our definition, all cases from the clinical as well as the bacteriological standpoint. With this in mind, the cases, it seems to me, group themselves naturally into four classes. First, those persons who are exhibiting the clinical symptoms of diphtheria, and in whose throats there are found the diphtheria bacillus of any recognized morphological type. These, we all agree, should be placed in quarantine. Second, persons who are not exhibiting any clinical symptoms of the

disease, but who are known to have recently been associated with cases of clinical diphtheria and in whose throats are found those forms of the diphtheria bacillus which ordinarily were virulent. These persons should be placed in quarantine. Third, persons showing no clinical symptoms of the disease and who are known not to have associated with clinical cases, or who have not had an opportunity for infection, yet in whose throats morphologically typical diphtheria bacilli are present. It is a question as to whether such persons should be placed in quarantine. Certainly the establishment of quarantine in such cases should be regulated by the surrounding conditions. After once the pathogenesis of the organism present is established, the persons should be placed in quarantine. Fourth, we have a class of persons who exhibit no clinical symptoms of the disease, who are known not to have had an opportunity to become infected from clinical cases, and yet in whose throats or noses there is present throughout a long period of time, an organism which morphologically is ordinarily not pathogenic to animals, but which occasionally may be virulent. This constitutes a large number of cases of infection with diphtheria-like organisms. We find these cases usually when we are making systematic investigations in our schools. In every one of them the pathogenesis of the organism found should be fully shown before quarantine is established. Individuals in public institutions or homes should be placed under surveillance while definite information as to the virulence of the bacillus is being obtained.

In formulating a definition of diphtheria for public health purposes, there must be kept in mind not only the establishment of quarantine, but equally important is the maintenance of quarantine. It would seem advisable that whenever a patient has once been placed in quarantine, he should be held there until two cultures, taken by a capable person synchronously from the nose and throat, show the entire absence of diphtheria bacilli. In the Minnesota State Board of Health Laboratory, I believe we have the record case of long persistence of the diphtheria bacillus in a throat. In this child, an inmate of a state institution, the organism, typical and virulent in a number of cultures, was found to be present throughout a period of over nineteen months, during which time there were made over seventy examinations. When such a case as this arises, we should show that the organism is nonvirulent before we permit the patient to be released from quarantine.

To recapitulate: Any definition of diphtheria for public health purposes must be wide enough to give warrant for the following executive acts:

FIRST. Place in quarantine those cases which show clinical symptoms and have present in their throats or noses diphtheria bacilli of types that we know are virulent, either usually or but occasionally.

SECOND. Place in quarantine those who have been known to associate with diphtheria patients and in whose throats typical diphtheria bacilli are found.

THIRD. Be guarded in placing in quarantine those persons not associated with clinical cases, and who may have in their throats even typical diphtheria bacilli.

FOURTH. Be extremely cautious,—certainly until the virulency of the organism is thoroughly established—in placing in quarantine persons not associated with clinical cases, and having in their throats only diphtheria-like organisms which ordinarily are not virulent.

FIFTH. Maintain quarantine in every instance either until examinations of two cultures, taken synchronously from the nose and throat of the patient, are negative, or until the non-virulence of the organism present is proved.

DR. PETER H. BRYCE, of Toronto, Canada.—There is one feature of this admirable paper which Dr. Hill naturally overlooked, namely, the legal phase which health officers have to deal with when they meet with a case of diphtheria. I believe all of us recognize that the old form of quinsy was due to a germ of some form or other. Most of us know that it is a disease which in many cases assumes a very virulent form, and we have experienced certain forms of streptococcus or diplococcus infection that are identical with infectious diseases.

With regard to the definition of the word diphtheria, the old French word *diphtherite* meant a false membrane, and in our courts in Canada, and I believe in most of the courts in the United States, the word diphtheria is translated legally to mean a false membrane in the throat. If the Doctor had only touched on the point as to whether we are going to recognize as a contagious disease to be isolated a streptococcus infection, then I think he would almost cover the ground which he discussed so admirably with reference to the diphtheria germ. As a matter of fact, we now largely relegate diphtheria to the Klebs-Lœffler bacillus. If this be true, then we will have to revise our terms from a legal standpoint. Personally, knowing the difficulties attending the diagnosis of various forms of diphtheria, and recognizing the possibility of a mixed infection, I would be slow indeed as an executive officer to leave a loop-hole in our measures to control a disease with false membrane in the throat, trusting entirely to the laboratory which may not be available at an early stage of the disease, owing to the possibility of doubt, and Dr. Wesbrook's extensive work has shown that even

the laboratory itself may be at fault as to the true character of the disease.

I would agree with the last speaker as to the two classes of cases of diphtheria which should be quarantined. With regard to the others, it would be practically an impossibility to deal with them from the legal standpoint of quarantine. These persons have not the disease; they have not been exposed to it, and it would be carrying the matter a good deal further, I am afraid, than our authority would warrant. To take any person who has not diphtheria, although he may have the diphtheria germ in his throat, and say to him he must be put in quarantine, is going too far. There is a practical phase of the question which we have to deal with, and I certainly believe that we should restrict quarantine to the first two classes, and I would ask the reader of the paper to discuss the question from his knowledge as to whether we ought not to keep severe cases of membranous sore throat in hand, even from the standpoint of the prevention of streptococcus disease, which may subsequently prove communicable.

Dr. W. C. Woodward, of Washington, D. C.—Following the line of thought suggested by Dr. Bryce, the most important point of this subject is its legal phase. The solution of it from the standpoint of the working health officer will be, I believe, along the line of the modification of rules of evidence. As Dr. Bryce has suggested, when the question comes before a court, the meaning of the word diphtheria will be discussed and determined largely by its definition at the time the law was enacted under which the prosecution is brought. There is a very wide difference between clinical and bacteriological diphtheria. I do not believe the prosecution would have much ground on which to build a case when there was no evidence of illness.

Even in other cases difficulty may arise in securing evidence upon which to base prosecutions. No man can be compelled in a criminal prosecution to bear evidence against himself, so that if we rely too much on the results of bacteriological examinations we may find ourselves embarassed when attempting to prove that any case, on which prosecution may have been brought, is really a case of diphtheria. We have no right to take cultures by force, and then say that the person from whom they came has diphtheria. If, therefore, we hold that the finding of the Klebs-Lœffler bacillus is essential to the determination of the nature of the disease, we may find ourselves unable to prosecute. In order to meet the difficulty, it is necessary to place the burden of proof, if we can, on the patient. In recent legislation in the District of Columbia relative to major contagious diseases, this has been attempted by making the clinical symptoms prima facie evidence of the existence of the disease, so that if the health officer, or whoever is

bringing the prosecution, can show that clinical symptoms were present, it will be necessary for the defendant to prove that those symptoms did not arise from a specific cause. The law carries the matter one step further by providing that the presence of the specific bacillus shall be regarded as conclusive evidence of the presence of the contagious disease with which it is ordinarily associated. We have, therefore, reasonably well-guarded provisions which afford protection both to the patient and the people, by quarantining the infected person, and affording the health officer ground on which to work. So far as refers to raising the quarantine, our law provides that no patient shall be regarded as having recovered, so long as he is capable of transmitting disease to other persons. These provisions will afford us settled rules of evidence which may enable us to maintain our position when we have occasion to prosecute cases before courts of law. I regret to say, however, that they do not yet apply to cases of diphtheria.

Dr. Charles V. Chapin, of Providence, R. I.—This discussion is an extremely important one. The paper of Dr. Hill has attempted to define the word diphtheria, and perhaps I feel more strongly than many of the members do the necessity of defining it. Dr. Swarts and myself were once subjected to heavy suits for damages because we and the judge differed regarding the meaning of the word diphtheria. It hardly seems necessary to pass a resolution regarding the definition of the word diphtheria. It is general custom and usage which gives a true definition to a word. We can do very much more by discussion and by ourselves restricting the term diphtheria to a certain class of cases. The word should be restricted to that class of cases in which the clinical symptoms are developed. Undoubtedly, we will have similar problems to solve in regard to other infectious diseases, and I think this is an opportune time to have the subject considered very carefully, so that we can come to a reasonable conclusion as to the best definition of the word.

I agree with what Dr. Hill has said. Of course, if we recognize that this definition is restricted in this way, we shall have to modify our laws as suggested by him and Dr. Woodward. I very much fear, however, that it is not an easy matter to enact laws in which two classes of cases shall be referred to in such a manner that there will not be loop-holes for escape. As Dr. Woodward has just stated, quarantine should be maintained as long as the patient is capable of transmitting the disease to others. It would be difficult to successfully maintain such quarantine under present regulations; but if we realize that the court is going to hold that diphtheria is to be applied only to those cases in which there are clinical symptoms, then we can govern ourselves accordingly and try to modify the law so as to fit our present conceptions.

Dr. R. O. Beard, of Minneapolis, Minn.—It is inconceivable to me that, in a case of this kind, a judicial decision should turn upon the derivative significance of the word diphtheria. It has not been the custom of the courts to pass upon questions of this sort either from an etymologic standpoint or from the standpoint, even, of the common acceptation of a word. Where a term is essentially scientific and is employed by scientific experts, it has been a rule of practice, I think, to take expert evidence of its current scientific meaning. The testimony of any two or three medical men would surely weigh with a court in determining what the term diphtheria means to-day rather than what it meant at the time the word was coined.

If the etymologic significance of a scientific term were insisted upon there would be the greatest need for a revision of the nomenclature of disease, for similar difficulties would obtain with other contagious diseases than diphtheria.

It strikes me that a point of very much greater importance than this, is the question of the practicability, from a legal standpoint, of maintaining quarantine in cases of recovered diphtheria for long periods of time upon the bacterial evidence of a persisting infection of the throat. I do not wish to be understood as questioning the scientific accuracy of the laboratory view, or the correctness of the attitude which Dr. Wilson takes toward the two classes of cases which he says should be quarantined; and, yet, it seems to me that when we have to put this matter into actual practice, as health officials, and have to rely upon the decisions of law courts to sustain our action, we must be governed by the interpretation which the court is likely to put upon a reasonable application of quarantine. Quarantine is an exhibition of police power and police power has always been justified by the courts within reasonable limits. I doubt whether the definition of reasonable limits could be stretched, in the event of a judicial test, to cover a period of seventeen months or seventeen weeks.

I would suggest that it is important for bacteriologists to settle the average duration of the pathogenic qualities of the Klebs-Lœffler bacillus. A law of averages upon which to work would be of value to health officials.

I would like to ask Dr. Hill and Dr. Wilson whether the pathogenicity of the bacillus has been shown, so far, to be affected in its duration by the use, in the infected person, of antitoxin. It might be a useful thing to determine whether the use of antitoxin has not an influence in shortening the period of the physiologic activity of the bacillus.

Professor William H. Welch, of Baltimore.—I did not hear Dr. Hill's paper and therefore cannot discuss it intelligently. I wish, however, to refer to a few points that came up in the discussion. The

divergence between so-called clinical and bacteriological diphtheria is much less than is often supposed. It is self-evident that nothing should be called diphtheria in which there are no clinical symptoms of the disease. With the presence of the Klebs-Lœffler bacillus alone, there is no more reason to say a patient, who has a perfectly healthy throat, is infected with diphtheria, than there is reason to say that a man has pneumonia simply because he has the pneumococcus in his throat.

With reference to the divergence between the bacteriological and the clinical diagnosis of the disease, I am of the opinion that nearly every case in which the physician confidently makes a diagnosis on purely clinical grounds of primary pseudo-membrane diphtheria it is due to the Klebs-Lœffler bacillus. It has been our experience in Baltimore that over 90 per cent. of the cases of pseudo-membranous angina examined bacteriologically have been proven to be true diphtheria.

Many of you are doubtless familiar with Jacobi's work on this subject, who years ago brought forward evidence that true diphtheria could occur in the form of a mild catarrhal angina or follicular tonsillitis. The recognition of these mild cases by bacteriologists does not constitute any revolution in clinical conception of the disease .

I agree entirely with Dr. Wilson's recommendations as to quarantining those ill with diphtheria, or those who have been exposed to it and are known to carry the diphtheria bacillus. With regard to the other cases, it seems to me we need further information as to the danger from those who have not been exposed but are incidentally discovered to have the diphtheria bacilli in their throats. I would ask Dr. Wilson if he has any information as to the conveyance of the disease from such individuals?

Dr. J. J. Mackenzie, of Toronto, Canada.—I have had considerable experience with diphtheria cases in a children's hospital in Toronto, and in most of the cases in which we examine the nasal secretions we find the presence of an organism which is fairly typical of the disease. Lately we have made it a practice to always take swabs from the nose and throat of children that come in, and in spite of this, cases of the disease occur. It is difficult to isolate children who are not suffering from anything serious, and great objection is raised to such isolation. However, the children are sent up to the isolation ward when we find sufficient evidence of the disease as shown by the material taken from their noses. Every now and then we would have a case or two of diphtheria in the wards, and yet it was exceedingly difficult to trace the source of infection. Cases occurred here and there through the wards in spite of careful examinations of the throats and noses of the children for evidence of the existence of the bacillus. There does not

seem to be as much danger of infection in these cases as in true diphtheria. I have isolated the organism from the nose on seven different occasions; it is of low degree of virulence. In guinea pigs it produced sometimes an induration, which lasts for a week or so. It is difficult for a medical man to say when it will give rise to a case of true diphtheria and the case should be isolated as such.

Dr. Henry D. Holton, of Brattleboro, Vt.—Three or four years ago in a village of fifteen hundred inhabitants we had in two years repeated outbreaks every two or three months of cases of diphtheria. I inspected the condition of the village and was of the opinion that they had not quarantined strictly enough; this they subsequently did. One physician took from the throats of a book-seller, a mechanic, and of two physicians, who had not seen a case of diphtheria for six months, cultures, all of which showed the presence of the Klebs-Lœffler bacillus. It seemed to me that the explanation for these repeated outbreaks in that village was that these and perhaps other persons were walking about the village at different times with the Klebs-Lœffler bacillus in their throats. We can understand that when they met persons whose general condition was not just right, or whose mucous membrane of the throat was in a catarrhal state, or in a condition to develop the false membrane spoken of, and which is such important evidence of clinical diphtheria, they might infect them, and thus we accounted for the persistence in that village of the repeated outbreaks of this disease. I will say further, that those persons who were found pursuing their business and yet having these bacilli in their throats were given some treatment for the throat calculated to destroy the germs. How many others among the fifteen hundred inhabitants in the same town were similarly infected I do not know.

About that time the outbreaks of diphtheria ceased, and for the last eighteen months there has not been a case of the disease in that village.

Dr. Hill (closing the discussion).—It is rather difficult to answer all of the points that have been brought out in the discussion, but there are a few to which I will endeavor to reply. The object of my paper was, first of all, to define the relation, if possible, of patient, bacillus and lesions. I think everyone here, in spite of all that has been said, would require that a case of the disease of diphtheria should possess these three factors; that is, we must have a patient, then the bacillus and finally the lesions produced by it. What these lesions are is another matter. We cannot insist that the lesion shall be a membrane, because it is well known that diphtheria may appear without the presence of a real membrane. Some lesion, however, is necessary in order to constitute the disease. On the other hand, typical lesions, if due to some other cause than the bacillus, do not make the case diphtheria.

With reference to the legal complications which might ensue, I tried to get over that point in my paper, especially the point of objecting to the necessity for a bacteriological examination. Regulations should read, "Cases reported as diphtheria, or as infected with the diphtheria bacillus." This wording leaves to the court the consideration of two main points, either the presence of the disease or the presence of the bacillus, which cover all the complications, so far as I can see. If you can get a physician under such wording of the regulations to state that a certain case is one of diphtheria, you are then in exactly the position you are now with regard to the legal definition. If you cannot get this, but can demonstrate the bacillus, you have in addition exactly the phrase which gives the right to isolate or to treat the case. So far as isolation is concerned on the basis of a bacteriological examination, our new definition is not opposed to our present definitions of diphtheria, it simply adds to them. The second factor, the presence of the bacillus, is that which will permit the isolation of cases whether the lesions of the disease are present or not.

Several valuable points were brought up by Dr. Wilson in his remarks, one with reference to the correlation between variations in morphology and virulence, and other subjects, none of which, however, affect the definition given. Those are matters for bacteriological decision and ought to be considered before the bacteriologist gives his diagnosis of the presence of the organism. On this point, the matter becomes one of credibility or reliability on the part of the witness in legal matters, and if the bacteriologist cannot be trusted to say whether the organism is the diphtheria bacillus or not after an examination, the case falls to the ground. The bacteriologist should determine that point beforehand. If the matter is in doubt, scientifically the bacteriologist must express that doubt in his report or withhold his report. But so long as he has made a statement, then you can fit it in with the definition.

So far as the isolation of cases is concerned, on the discovery of the bacillus, if there is any question as to the virulence of the bacillus, I believe it is better to keep the patient in quarantine until the test is complete, rather than take the chances of letting the patient go, hoping that the bacillus may turn out to be non-virulent, and this because in the majority of cases, the organism is virulent, if it is the true diphtheria organism. If you are sure the organism is the diphtheria bacillus say so and stick to it, leaving the ifs and buts relating to other cases and possibilities for discussion at some other time, not in the witness box. If you are sure it is not the diphtheria bacillus say *that*, and stick to it. If you are in doubt, let the case drop. If you can't let it drop, go to court and say you are in doubt, and explain why, even in doubtful

cases, the public health requires that the public should receive, so far as possible, the benefit of the doubt.

Dr. Wyatt Johnston, of Montreal, Quebec, presented the following "Report of the Committee on Laboratories":

MR. PRESIDENT—I beg to report that the Laboratory Committee has been organized in accordance with a resolution adopted by the Ottawa meetings last year. The object of this resolution was to develop the scientific laboratory work in connection with the Association and to increase the membership among persons actively engaged in laboratory work.

The number of adherents secured by this committee is nearly one hundred as will be seen from the published list. Of these nearly half are new members.

The expense incurred in connection with circulars, etc., sent out amounts to $20.35, for which I append vouchers, and would ask that the amount be reimbursed. The expenses of postage and stationery were voluntarily assumed by the Board of Health of the Province of Quebec.

All those whose co-operation was asked showed the greatest willingness in advancing the objects mentioned, which made the work of organization surprisingly light and pleasant.

Feeling that it would be necessary to secure the co-operation of some one pre-eminent among laboratory men and known by all as a leader in the scientific work, I asked Prof. W. H. Welch to act as honorary chairman of the committee. His consent to do this contributed more than anything else to the success of the work, and I feel that he has rendered an important service to the Association. I may mention that, as far as the scientific work of the Association committee is concerned, Prof. Welch has been the presiding chairman. This enabled me to act as secretary and organizer of the committee with greater freedom.

It was decided, after conferring with the officers of the Association, to hold a meeting for the reading of technical papers one day before the regular meeting. At the same time the general secretary was given the option of adding to the general program any paper offered to the Laboratory Committee, but of a nature to interest the general meeting. The committee meetings were open to all members of the Association and care was taken that no committee meeting should conflict with the general meeting of the Association. If technical papers of a bacteriological or chemical nature offered for the general meeting were referred to the secretary, time might be saved at the general meeting.

The character of the papers presented this year for the committee will be seen from the printed programme.

The success of this meeting was largely due to the admirable arrangement made for its accommodation and entertainment in the Medical Science Building of the University of Minnesota.

It seems to me possibly feasible to hold occasional sessions of the committee during the days of the meeting, without interference, by selecting hours before the regular meeting, for instance 9 a. m. In this manner the detailed and technical discussions could be afforded increased time without increasing the total number of days' attendance necessary.

I wish to point out, in view of the large and increasing membership of the committee, that under the constitution appointment by the President of the Association or appointment by the chairman of the commiittee, to whom that power may have been delegated, is the only means of securing additional members. This, in the case of a large committee, places a very heavy responsibility upon these officers, and the chairman, especially where applications for membership on a committee are received. If some method of nomination to such large committees could be adopted similar to those followed in the case of sections of other societies, the difficulty would be got over, while the interest of the Association could be safeguarded by leaving the final appointment in the hands of the general Association or of its President.

It will be noticed that both bacteriologsits and chemists are on the committee and it would be necessary perhaps to arrange the meetings of the committee or section so that the papers presented by each may come before an audience competent to discuss them.

In the case of a future meeting, it might be better to eliminate a number of subjects upon which contributions are asked for, especially those where progress could be made by technical discussion of them, so that a large number of members could be invited to contribute to the discussion. These formal discussions might take precedence over isolated papers in certain sessions.

I wish to state in conclusion that the unanimous opinion of the committee is that it should be, if possible, transformed into a section of the Association subject to the restrictions indicated above, and in case this is accomplished at the meeting the committee, as now constituted, has affirmed by resolution that its mission will have been completed and would ask to be discharged. I would recommend that a grant to the amount of $100 be allowed from the general funds for carrying on the work during the next year. The recommendations made by the committee with reference to the lines upon which the sections might be organized, having been submitted directly to the Executive Committee, need not be detailed here.

At the conclusion of the report, Dr. Johnston asked that the Laboratory Committee be discharged, as further provision for work of this nature had been already provided in the establishment of the bacteriological and chemical section.

On motion of Dr. Gibson, the committee was discharged, and a bill amounting to $36.35, covering the expenses of the stenographer for the committee, was ordered paid by the Treasurer.

Dr. Benjamin Lee.—I believe the committee has asked for an appropriation for the ensuing year, and I would like to ask whether it is to be acted on here or in the Executive Committee.

The President.—I think the Association can vote on such an appropriation without its reference to the Executive Committee.

Dr. Benjamin Lee.—I would move that the Treasurer be authorized to furnish an appropriation of $100 for the use of this committee and section during the ensuing year. Seconded and carried.

On motion, the Association then adjourned until 3 o'clock.

Third Day—Afternoon Session.

The Association reassembled at 3 P. M., and was called to order by the First Vice-President, Dr. Monjarás.

Dr. Eduardo Licéaga, of Mexico City, Mexico, contributed a paper on "Instructions to Persons Suffering from Diseases of the Chest, and to Their Attendants, and for Preventing the Diffusion of such Diseases. (See page 261.)

Dr. R. O. Beard, of Minneapolis, Minn., read a paper on "The Nature Treatment of Tuberculosis." (See page 249.)

Dr. A. Walter Suiter, of Herkimer, N. Y., offered the following preamble and resolution:

Whereas, The encouragement of the endowment of research in the science of etiology in prevention of disease is entirely within the province and mission of the American Public Health Association; and,

Whereas, By recent legislative action the State of New York has taken a decisive step in advance by the grant of an annual appropriation for the establishment and maintenance of a laboratory with all modern appliances for the persistent prosecution of studies in the etiology of cancer; and,

Whereas, Results have already been obtained which lead to the hope that the discovery of the etiological factor in the production of this much-dreaded disease may be at hand; therefore, be it

Resolved, That the American Public Health Association takes this occasion to place upon record its approval of all similar efforts to the

end that State and National patronage in special and general scientific research may be universally established. (Referred to the Executive Committee.)

A paper by Dr. E. A. de Schweinitz, of Washington, D. C., entitled, "Report of the Proceedings of the International Congress for the Consideration of the Best Method of Checking or Curing Tuberculosis, held in Berlin, May 24 to 27, 1899," was read. (See page 255.)

DISCUSSION ON THE PAPER OF DR. DE SCHWEINITZ.

Dr. J. I. Gibson, of Denison, Iowa.—I would like to ask Dr. de Schweinitz if the International Congress sustained the tuberculin test as the proper means of cleaning out of dairy herds tuberculous cattle, and coupled with that question, I would like to know, if possible, what was recommended by that great body as to the proper disposition to be made of animals reacting to the tuberculin test.

Dr. de Schweinitz.—In reply to the gentleman's question, I will say that there were no resolutions or votes taken giving a general expression of opinion on the part of the members of the Congress in regard to any method or subject that was up for discussion. Many papers were read which gave a complete review of the knowledge of all branches of the subject of tuberculosis up to the present time. The men who were present discussed the value of the tuberculin test publicly and privately, and said it was the most valuable test that has ever been suggested, and one which we could not do without.

Professor F. C. Robinson, of Brunswick, Maine, under "Report of Committee on Disinfection and Disinfectants," said that the committee was not ready to make a full report at this time. Work was under way, but not completed sufficiently for a report. He fully expected that next year the committee would be able to present the results of several investigations by different members. In his own laboratory a series of investigations is being carried on relative to the action of formaldehyde on the bacillus of tuberculosis. He said he used, in addition to other forms of apparatus to supply formaldehyde, a simple apparatus made of copper and asbestos, in which formalin was first absorbed, and then by a common kerosene lamp vaporized into the room. It was inexpensive, and had proved very efficient.

Dr. Hibbert W. Hill, of Boston, Mass., read a paper (by title) on "Electrozone." (See page 273.)

Dr. Samuel W. Abbott, of Wakefield, Mass., read a paper on "Sixteen Years' Experience in Food and Drug Inspection." (See page 277.)

Dr. H. M. Bracken, of Minneapolis, Minn., followed with the "Report of the Committee on a National Leper Home." (See page 284.)

Dr. C. P. Wilkinson, of New Orleans, La., contributed a paper (by title) on "The Leper Home of Louisiana." (See page 285.)

DR. F. F. WESBROOK.—I move that a committee of five be appointed to secure such concessions as may be necessary from the Postoffice Department to permit the transmission through the mails of specimens of diseased tissues by the use of more convenient packages than those that are now employed. (Seconded and referred to the Executive Committee.)

On motion, the Association adjourned until Friday morning, at 10 o'clock.

FOURTH DAY—MORNING SESSION.

The Association met at 10 A. M., and was called to order by the President.

Announcements of local interest were made by the Chairman of the Committee of Arrangements, after which the President called for the report of the Executive Committee by the Secretary.

THE SECRETARY.—The Executive Committee has considered the resolution offered by Dr. Johnston, and recommends its adoption. (For resolution, see minutes of afternoon session of second day.)

On motion, the recommendation was concurred in.

THE SECRETARY.—The Executive Committee has carefully considered the resolution offered by Dr. Suiter, and recommends its adoption in the amended form, as follows:

WHEREAS, The encouragement of the endowment of research in the science of etiology and prevention of disease is entirely within the province and mission of the American Public Health Association; and,

WHEREAS, By recent legislative action the State of New York has taken a decisive step in advance by the grant of an annual appropriation for the establishment and maintenance of a laboratory, with all modern appliances for the persistent prosecution of studies in the etiology of cancer; therefore, be it

Resolved, That the American Public Health Association takes this occasion to place upon record its approval of all similar efforts to the end that State and National patronage in special and general scientific research may be universally established.

On motion of Dr. Holton, the resolution was adopted as recommended in its amended form.

THE SECRETARY.—With reference to the definition of the term epidemic, as given by the "Committee to Define what Constitutes an

Epidemic," the Executive Committee reports it to the Association with the recommendation that it be referred to the committee for the ensuing year.

DR. HOLTON.—I move that this definition be referred to the Committee to Define what Constitutes an Epidemic, to be appointed for the coming year. Seconded and carried.

The definition, as given by the above committee, is as follows: "An epidemic is an outbreak of a communicable or infectious disease affecting a dozen or more individuals in quick succession before the recovery of the first case, whether arising from a single focus or from several foci in a neighborhood."

THE PRESIDENT.—The next thing in order is the report of the Advisory Council.

REPORT OF ADVISORY COUNCIL.

MINNEAPOLIS, Nov. 2, 1899.

To the President and Members of the American Public Health Association:

GENTLEMEN—Your Advisory Council begs to report that it has performed the duties required of it in what it trusts you may regard as a satisfactory manner, and submits for your approval the following nominations for officers of the Association for the ensuing term, viz.: For President, Dr. P. H. Bryce, Toronto, Canada; for First Vice-President, Dr. H. M. Bracken, Minneapolis, Minn.; for Second Vice-President, Dr. Juan Breña, Zacatecas, Mexico; for Secretary, Dr. C. O. Probst, Columbus, Ohio; for Treasurer, Dr. Henry D. Holton, Brattleboro, Vt.; for members of the Executive Committee (for two years), Dr. J. L. Leal, Paterson, N. J.; Dr. C. P. Wilkinson, New Orleans, La.; Dr. J. F. Kennedy, Des Moines, Iowa; (for one year), Dr. A. W. Suiter, Herkimer, N. Y.

In compliance with the resolution of your Association regarding the nomination of officers for the several Sections, your Advisory Council begs to present the following list of officers for the "Section of Bacteriology and Chemistry," the same having been submitted by the members of that section, viz.:

Chairman—Dr. Theobald Smith, Boston, Mass.

Vice-Chairman—Dr. F. F. Wesbrook, Minneapolis, Minn.

Secretaries—Dr. Wyatt Johnston, Montreal, Quebec, and Dr. Adolph Gehrmann, Chicago, Ill.

Members of the Sectional Committee—Dr. José Ramirez, Mexico City, Mexico; Professor W. L. Russell, Madison, Wis.; Dr. Gardner T. Swarts, Providence, R. I., and Mr. H. W. Clark, Boston, Mass.

For Executive Officer—Professor W. H. Welch, Baltimore, Md.

The Council also presents the city of Indianapolis, Indiana, as the place in which to hold the next annual meeting of the Association.

Your Advisory Council desires to congratulate the Association upon the evidently high appreciation with which it is regarded by the public, as shown by the fact that no less than six pressing invitations were received from as many different cities, to hold the next meeting in their midst. These invitations were not only extended by the State and municipal authorities, but also by business men's leagues and chambers of commerce, thus indicating that this Association has taken high rank as a representative sanitary body, and that its work in the interest of the public health is being regarded as most thorough and scientific, and therefore commends itself not only to the people at large, but also to the vast and influential business community.

The reception of so many invitations, each presenting in the most glowing and captivating terms the peculiar advantages possessed by the several cities, was a source of considerable embarrassment to the members of the Council in the making of a selection, indeed so much so, that many of them were almost inclined to exclaim with the lovelorn one:

> "How happy could I be with either,
> Were t'other dear charmer away."

While other cities offered many and most tempting inducements of a material character, the selection was finally made in response to the positive assurance that the city named will tender us "A feast of reason and a flow of soul" such as can only be prepared by statesmen, philosophers, poets and novelists. Thus was again manifested the vast superiority of mind over matter. Respectfully submitted,

CROSBY GRAY, Secretary.

On motion, the report of the Advisory Council with its recommendations was adopted, the Secretary being instructed to cast the ballot of the Association for the officers named, which he did, and they were declared duly elected.

THE SECRETARY.—The Executive Committee recommends the appointment of the following committees: "Committee on Transportation of Diseased Tissues by Mail," and a new "Committee on Teaching of Hygiene and Granting of Degrees of Doctor of Public Health."

THE PRESIDENT.—What action will you take in regard to these recommendations?

On motion, the recommendations of the Executive Committee were concurred in.

The following resolutions of thanks were offered by Dr. Holton:

Resolved, That the thanks of the American Public Health Association be extended to Governor Lind; to the President and members of the Board of Trustees of the Minnesota University; to the State Board of Health; to the Honorable Mayor Gray and City Council of the city of Minneapolis; to the President and Fellows of the Academy of Medicine; to the Hennepin County Medical Society; to the Commanding Officer at Fort Snelling; to the Chairman of the Local Committee of Arrangements, Dr. Beard, and the members of the several sub-committees; to the Ladies' Reception Committee for their uniform courtesy and kindness extended to the members of the Association and their friends.

Resolved, further, That the thanks of the Association be extended to the railroads for granting reduced rates, and to the gentlemen of the press who have continuously attended and reported the proceedings of the Association.

On motion, the resolutions were unanimously adopted.

THE PRESIDENT.—The next thing in order is a paper by Dr. Benjamin Lee, of Philadelphia, Pa., on "Treatment of Garbage and Excreta in Military Camps." (See page 287.)

Mr. Macdonough Craven, of New York City, read a paper on "Waste Disposal and Its Advances." (See page 293.)

Colonel W. F. Morse, of New York City, followed with another paper entitled, "The Next Step in Waste Disposal Work." (See page 312.)

DISCUSSION ON THE PAPERS OF DR. LEE, MR. CRAVEN AND MR. MORSE.

DR. W. C. WOODWARD, of Washington, D. C.—We are indebted to the gentlemen who have read these papers for their thorough study of the subject of garbage disposal, and the satisfactory manner in which they have presented it. The matter has interested me for some years past and is at present of particular importance to me, as the District of Columbia will have to face this problem anew during the coming year. I cannot say that I have personally a strong preference either for the reduction system or for cremation; I think the choice must depend largely upon local conditions. My observations have led me to believe, however, that crematories can be rendered much less offensive than reduction plants. The financial aspects of the case, too, will vary in different places, and this will apply not only to the disposal of garbage pure and simple, but to the saving of valuable material from miscellaneous refuse. Many articles can be collected and sold in New York City or in Boston, at a profit, which will not find a market in places more remote from manufacturing centers, on account of the cost of transportation.

Another point that a city must consider is the available locations for the establishment of crematories, garbage reduction works, or of works for saving valuable material from refuse of various sorts. New York is well situated in this respect. Notwithstanding this, the reduction plant has been complained of as a nuisance, and an effort was on foot, but to what extent it proceeded I do not know, to have the present establishment abolished. It would be well if Mr. Craven would enlighten us on this point. The information I had was that the inhabitants of Coney Island complained bitterly to the State Board of Health of existing conditions.

After listening to both of the papers which have been read, there is one point I do not understand. The best figures given are from abroad, from England and Germany. The German methods may be considered better than the English. We find, however, that there is no effort at reduction of garbage in either place, in the sense in which we understand that word; there is no effort to save the grease and to utilize the so-called tankage as fertilizing material. If they find it advantageous in England and Germany to collect all material together, to burn it, and to save whatever there may be of value in it in the form of energy, does it not teach us that we should try to do the same? I would like to know, too, whether, in any American city, there are utilization plants located in the heart of the municipality, as are the crematories of London.

Dr. Louis Laberge, of Montreal, P. Q.—I desire to say that for three or four years past we have had in use in Montreal a garbage destructor, based on the English system. It has a large smoke-stack of a hundred and eighty feet in height and a horizontal stack that serves as a dust chamber. The object intended to be effected by this apparatus, which is worked at a high temperature, is to insure the complete destruction of the refuse. In Montreal we are destroying the garbage for one-third of the city. We destroy on an average eighty-five tons of mixed garbage and ashes a day. The operation of this destructor has given perfect satisfaction to the public. It is operated at a cost to the city of $14,000 a year.

Mr. Craven (closing the discussion).—With reference to the utilization system as we find it in New York, I will say that when the garbage plants used were first erected, they were conducted with very little annoyance; then complaints were received from a small section of the country that was due west from the plants. These complaints came frequently when there was a north or south wind.

The progress that has been made in reducing the nuisance which came from the utilization plants has been very great in the past year, so much so that only one complaint has been received by the Board of

Health of our city during the past five months. The buildings are made air-tight; the air is exhausted, and none of the steam and disagreeable odors can get to the outside atmosphere. The vapors, etc., that are taken from the building are put through a system of scrubbing that seems to effectually do away with a nuisance which at one time was apparent. I have noticed that formerly at a distance of a mile and a half there was at times more or less odor, and in the past few months I have not been able to get those odors away from the immediate vicinity of the plant. It was unfortunate in having the factory located in a section of the country in which there was a fish factory, so that it took about two years to distinguish the various odors that came from Barren Island, and at first I thought everything I smelt came from the reduction plant, but found that the nuisance came from other places.

As to the utilization of garbage abroad, I believe it is true that there are no utilization plants. Compared with the United States the quantities of garbage are small and what there is of it is not rich in greases or fertilizing bases. The raw garbage is generally hauled several miles out into the country; in some cases it is transported by train and used as a fertilizer in its crude state. In Paris this has been done for many years and is still going on. The expenses have increased so much, however, that it now costs in the neighborhood of sixty to seventy-five cents per thousand kilos for transportation and almost an equal amount for other expenses. The parts of the country where this refuse is used are building up, and complaint is being made. Therefore, the use of this material is being restricted. Paris is now looking for other means of disposal of garbage. After about four or five years of investigation, the reports of which cover some three hundred-odd pages, they have decided that three or four methods are to be considered. One is the present method, but it is to be modified in some way to make it cheaper. Another is treatment by steam or utilization; another method is by composting, and the fourth is what is called auto-distillation. I do not know exactly what they mean by that term, but I believe they put the garbage through a destructor in which it is dried as it approaches the fire. It is swept toward the fire by a mechanical stoker. The ashes are used for fertilization I believe, and the vapors and gases which come from this furnace are treated in some way so as to recover the chemicals that may be of benefit. The city of Paris has decided that these four methods are pretty good and has also decided to test all of them, but I do not know what has been the outcome.

At this juncture the President arose and said: I wish to thank the members personally, who have been in attendance at this meeting, for their forbearance and kindness to me during the sessions. I desire to congratulate the Association on the fact that it has received a large

number of new members at this meeting. I believe that this meeting will rank as one of the most prosperous, instructive and satisfactory that we have ever held. The Secretary informs me that a hundred and twenty-five new members have joined this year.

I wish now to introduce to you your newly elected President, Dr. Peter H. Bryce, of Toronto. (Applause.)

Dr. Bryce was warmly received. He said:

MR. PRESIDENT AND MEMBERS OF THE ASSOCIATION.—I desire to thank you very heartily for the distinguished honor which has been conferred upon my country, and, incidentally, on myself in electing me to the position of President of this National Association for the coming year. I especially recognize this honor as due to my country, from the fact that she has shown during the fifteen years in which she has been associated in the membership of the American Public Health Association an active interest in all that pertains to the work which the Association has undertaken to accomplish, and if any of this honor is due to myself, it is attributable to the fact that during all of these years I have been a faithful attendant at your meetings, and, in so far as I have been able and competent, have taken a small share in making the work of the Association advance to such a point as we find it to-day. During the last fifteen years every one of us will recognize that the work of the Association has definitely enlarged; that we have taken in our neighbors from the Mexican Republic, and the horizon of our work has not only broadened, but our knowledge regarding the operations within that horizon have become more definitely exact. I trust during the coming century this work will be more greatly enlarged, and it will be a source of satisfaction to myself if during the coming year I shall advance this work. I shall do the best I can in the interest of the Association. Any further thoughts are not necessary at this time. I desire to thank you, again, for the honor you have conferred upon Canada and incidentally myself. (Loud applause.)

DR. BENJAMIN LEE.—With reference to the statement just made as to the membership and of enlarging the Association, I desire to announce the formation in the newly acquired State or Territory of Porto Rico, of a Superior Board of Health. It so happens that the Secretary of this Board of Health was a former President of the Board of Health of the State of Pennsylvania—Dr. George G. Groff, a gentleman whom many of you have had the pleasure of meeting, and I presume it will not be necessary, inasmuch as Porto Rico is now a part of the United States, to move that that Board of Health be included in the membership of this Association. If it is necessary, I would like to make a motion to that effect, but I should presume that it would be naturally in-

cluded, and I would simply request that the Secretary address communications to Dr. George G. Groff, Secretary of the Superior Board of Health of Porto Rico, when he finds it necessary to address communications to boards.

DR. TURNER.—I would also suggest that the Territory of Hawaii be added.

Dr. C. Hampson Jones, of Baltimore, Md., read a "Report on Work with Antitoxin and Formaldehyde Against Diphtheria." (See page 333.)

DISCUSSION ON THE PAPER OF DR. JONES.

DR. WILSON, of Minneapalis, Minn.—I would like to ask Dr. Jones what provision was made at the homes of the children who were sent away from school, if any, to prevent their mingling with other children?

DR. JONES.—There was no special provision made except the orders of the department that the children should be kept at home and their throats treated. The people of Baltimore are gradually being educated with regard to antitoxin in the treatment of diphtheria, but I have had to go very slowly in my efforts. I have succeeded in carrying out many things that were at one time supposed to be impossible, and until the physicians of Baltimore recognize that a child is dangerous when its throat is infected, just as much so as when its clothing is infected, I have to go slowly in compelling the child to be isolated, so that nothing, except the recommendations of the Health Department, has been carried out.

DR. WILLIAM R. STOKES, of Baltimore.—Just a word with reference to quarantining certain cases of non-clinical diphtheria. In Baltimore we do not absolutely quarantine healthy children that have diphtheria bacilli in their throats, yet, as Dr. Jones has said, the children are ordered home by the Health Department and cannot return to school again until negative cultures have been taken from all of the children's throats in the house. The point, then, I wish to emphasize is that while the child is not actually quarantined unless there is a case of clinical diphtheria in the house, yet it is kept away from school, and some good is accomplished in that way.

Another point has not been mentioned, and it is this: We make it a routine practice of placing a test culture in every room that is disinfected. We disinfected over three thousand rooms last year, and a test culture was placed in most of these rooms. If the inspector does not report on his card that the room is practically impossible to thoroughly disinfect, if the test culture grows, we then send a disinfector back to disinfect the room or rooms which still show a positive test culture.

Dr. Liston H. Montgomery, of Chicago.—In discussing Dr. Jones' paper, I desire to say that in the city of Chicago, when diphtheria is early diagnosticated and antitoxin is used early and freely, the death rate is exceedingly small. Practically every case is saved, if seen within the first twenty-four hours, by the Health Department, as well as in private practice.

Dr. Cressy L. Wilbur, of Lansing, Michigan, Chairman, presented the report of the Committee on Demography and Statistics in Their Sanitary Relations. (See page 337.)

The "Report of Commissions on the Revision of Classification of Diseases" was presented (*a*) for the United States, by Dr. Samuel W. Abbott, Wakefield, Mass.; (*b*) for Canada, by Dr. Peter H. Bryce, of Toronto, Ontaria. Dr. Bryce simply made a report of progress. (*c*) For Mexico, by Dr. Eduardo Licéaga, Mexico City, Mexico. (See page 353.)

Dr. Liston H. Montgomery, of Chicago.—In view of the lateness of the hour, and as there are so many papers to be read and some miscellaneous business transacted, I move that the remainder of the papers on the program be announced by title and referred to the Publication Committee, to be incorporated in the Proceedings. Seconded and carried.

The following papers were then read by title by the Secretary:

1. "Methods of Compilation Used in Preparing Census and Registration Reports," by Dr. Gardner T. Swarts, of Providence, R. I. (See page 357.)

2. "Representative Mortality Statistics," by Dr. Cressy L. Wilbur, of Lansing, Mich. (See page 368.)

3. "Contribution to the Study of the Contagious Character of Paludism and Its Prophylaxis," by Dr. Adolfo Patron Martinez, Mérida, Mexico. (See page 376.)

4. "Report of the Committee on Animal Diseases and Animal Food," by Dr. D. E. Salmon, of Washington, D. C. (See page 385.)

5. "Report of the Committee on Car Sanitation," by Professor S. H. Woodbridge, of Boston, Mass. (See page 389.)

6. "Dangers to the Public Health from Illuminating and Fuel Gas," by Mr. William Paul Gerhard, of New York City. (See page 411.)

7. "Some Preventive Measures to Diminish the Number of Abortions and Still-Births," by Dr. Manuel Gutierrez, of Queretaro, Mexico. (See page 430.)

8. "Notes on the Frequency of Certain Diseases Through Defects in Oxidation at High Altitude," by Dr. Juan M. Campos, of Toluca, Mexico. (See page 438.)

9. "The Prevention of Blindness by the Adoption of Laws Compelling Hygienic Precautions," by Dr. Walter B. Johnson, of Paterson, N. J. (See page 447.)

The following communication was read from the National Funeral Directors' Association, and on motion, the communication was received, and the Secretary instructed to acknowledge it with the thanks of the Association for the wishes expressed therein:

To the Officers and Members of the American Public Health Association:

The National Funeral Directors' Association of America sends greeting and again offers itself, its constituent bodies and its individual membership as coadjutors to you in your recognized efforts to protect the American public health.

We believe that many of the broadest and most frequented highways leading to grief and desolation which your body is endeavoring to cleanse and purify, lead past our doors where duty calls us to pass over them quite as frequently as it calls a large percentage of your membership who are not of our calling.

To the end that our connection with your honorable body may be of practical benefit to the great cause in the interest of which you are again met together, and that a new avenue to the relief of suffering and the saving of life may be opened, the National Funeral Directors' Association of America asks that you accept its services in the cause of disease prevention and general sanitation, hereby pledging its membership, individually and collectively, to second your every effort by the faithful and honest performance of every duty in connection with our business suggested by your wisdom as reasonable and proper, and wherein we can act as your co-workers in the saving of human life or the alleviation of human misery.

More clearly defining our opportunities in the direction indicated, I would suggest the following as but a few of the many heretofore greatly neglected opportunities, or features of health protection, falling properly within what may be termed the jurisdiction of the undertaker alone, and which are to-day either performed in the interest of humanity or neglected to its menace, according to the personal preference of the undertaker who is yet to be recognized by your Association as, in any degree, a sanitarian.

FIRST. The disinfection of the bodies of all persons dead from contagious diseases or noxious from putrefaction or other causes.

SECOND. The precautions necessary to be taken for the shipment by public conveyance of bodies permitted by existing rules of health boards and sanitary organizations, and the prevention of the shipment of those prohibited by the same rules.

THIRD. The care always necessary in the interment of similar cases at the place of death, as it relates to public funerals, disinfection, encasing, handling and transportation.

FOURTH. The care of our persons as it applies to ourselves, our families and those with whom we are brought into association.

FIFTH. The fumigation and disinfection of apartments, clothing, etc., in country, or outlying districts where only State boards of health are in authority, together with the fumigation and cleansing of carriages and other public conveyances used for funeral purposes and the destruction of infected articles of clothing, bedding and other accumulations of a sick room that has taken on the character of a death chamber, together with many other details of great importance that will suggest themselves to you as being immediately connected with our business, where no local health authority is in charge of such matters.

Our organization tenders this service without hope or desire of other reward from that accruing from a sense of duty performed in the interest of the saving of life and the prevention of suffering or, in other words, the "protection of the American Public Health," and most respectfully requests their acceptance, only asking that in our efforts to improve the qualification of the members of our calling by requiring in them a higher standard of efficiency, we may have your hearty cooperation and support in extending our efforts to all parts of the country.

Reference to our willingness and ability to at this time render you substantial service need not be made while so many members of your honorable body are, and have been, so deeply interested in our effort for recognition by the health authorities throughout the country which may truthfully be said to be at this time in full fruitage in nearly every State.

We trust that your meeting may accord us such recognition, believing firmly that in so doing you will substantially increase the usefulness of our organization, the qualification of our individual membership to better aid you in your work of caring for the American public health. With great respect and sincerity,

JOSIAH S. PEARCE,
President National Funeral Directors' Association.

Ardmore, Pa., October 26, 1899.

There being no further business, on motion, the Association then adjourned, to meet at Indianapolis, Indiana, in 1900.

REPORT OF MEETING OF LABORATORY COMMITTEE OF THE AMERICAN PUBLIC HEALTH ASSOCIATION, MONDAY, OCTOBER 30, 1899, LABORATORY OF MEDICAL SCIENCES, UNIVERSITY OF MINNESOTA, MINNEAPOLIS, MINNESOTA.

Meeting called to order by Professor W. H. Welch, of Johns Hopkins University, Honorary Chairman.

EXTRACTS FROM ADDRESS BY PROFESSOR WELCH.[1]

It may be acceptable if I say a few words about certain of the problems and lines of investigations in bacteriology, as these may suggest a few directions at least of work for the members of this Association.

First, a word as regards tuberculosis, which is, in a certain sense, unquestionably the most important problem for physicians when one considers that it is the most fatal of all diseases to the human race. There are two points that I would like to suggest in connection with this subject. One is, the need of further investigations with reference to the amount of danger to man which really results from tuberculosis in cattle. We have all, of course, general ideas upon this subject, but those who are familiar with statements in literature will note that there is much discrepancy—some minimizing the danger, while others doubtless exaggerate it. It is a very general impression that a large amount of tuberculosis in infants and children is due to infection from the milk of tuberculous cows. Now, is that so, or not? If we can do anything towards determining whether cases of human tuberculosis are of bovine origin or not, it would certainly clear up or at least shed a great deal of light upon this very important matter. Dr. Theobald Smith has indicated in what way this aspect of the problem can be hopefully attacked.

The second point is that we should have the courage of our convictions in applying to efforts to check the prevalence of this disease knowledge which has been gained from the study of the etiology of tuberculosis.

A word as to that ever important subject in this country,—typhoid fever. This is rendered specially urgent, I think, from the lamentable experiences during the recent Spanish-American war. It is well for us to draw lessons from such an experience as that. First, the mis-

[1] Some of the points presented in this address will be found in Dr. Welch's remarks at the general meeting of the Association (page 460).

takes in diagnosis, and second, the absence of application of the most elementary hygienic principles. I believe we teachers in the medical schools have something to account for in that connection. Those young physicians who were employed as acting surgeons, and others, have acquired their ideas from what they were taught in medical schools. Now, the fact that cases of malaria were diagnosed as typhoid, and a much larger number of typhoid cases diagnosed as malaria, shows that there is a defect in our teaching. To me, one of the lessons learned is, that we must insist upon better methods of instruction in the diagnosis of typhoid and malarial diseases. Then, the absence of the carrying out of very simple and well-understood principles of hygiene indicates that there must be some defect in the teaching of hygiene in our medical schools. A subject proper to consider here is what is feasible in the way of teaching practical hygiene in medical schools. It is quite clear that with our over-burdened curriculum we cannot make expert hygienists out of all students, but we should give them all at least some of the important elementary training. Opportunity should be given to those who desire it for more thorough training in hygiene, and those who choose to acquire that special training should receive some sort of a certificate indicating that they have such training, and that may be a step toward the fulfillment of that very urgent need that our public health officers should possess a diploma in public health.

We shall consider the problems of disinfection in our meetings, and this is a subject of constant interest. There is considerable dissatisfaction at present with procedures now in vogue, as to their application and their efficacy, in disinfecting rooms, and I think it would be well for us to consider whether we have not possibly followed too routine procedure in this matter; whether we have not tried to disinfect everything by one method; and whether it is not desirable to individualize more. Doubtless in those cases where the contagion is emitted only through fecal discharges, it is sufficient to disinfect, if possible burn, the bed and clothes and objects which are immediately and physically soiled. On the other hand, where the infectious matter is thrown off from the skin or from the air passages—and it is known that in the latter a fine spray even in ordinary speaking is emitted into the air—more extensive disinfection is needed than in cases of typhoid fever and dysentery.

With reference to the problems of sewage disposal I call attention to the interesting biological methods as promising of valuable results, but they have not thus far been so perfected that large communities are warranted in going to the expense of introducing them.

Finally as to a broader biological subject, namely, the differentiation of bacterial species, it may be said that characters which we hitherto often considered sufficient for the establishment of species really serve only to place a microorganism within a certain group. Take for instance such groups as the hog cholera, the colon, the typhoid groups how diffcult it is for us to say positively that a bacterium from some unusual source is in fact the hog cholera bacillus, the colon bacillus or the typhoid bacillus, and how much weight we must give in our decision to the source of the bacillus. There is evidence that bacteria which appear identical in all our cultural and experimental tests may in reality only be members of a group and possess different pathogenic powers in man.

By selecting these few examples I have attempted to indicate some of the directions in which this association of laboratory workers may contribute to the important work for which we are organized. The union of this Section with the American Public Health Association will, I believe, be of mutual advantage and conducive to the progress of public hygiene in this country.

STUDIES ON THE DISTRIBUTION OF CERTAIN VARIETIES OF THE DIPHTHERIA BACILLUS.

By F. F. WESBROOK, M. D.; L. B. WILSON, M. D.; O. McDANIEL, M. D.

(From the Minnesota State Board of Health Bacteriological Laboratory.)

In a former paper from this laboratory entitled, "A Preliminary Communication on Bacillus Diphtheriæ and Its Variants in a School in which Diphtheria was Endemic," the conditions of life favoring ready throat to throat infection were pointed out.

This school (see photographs on exhibition at meeting) consisted of five residence cottages, an administration building, in which meals were served and chapel held, a detention building for the reception of incoming children, a hospital, two school houses (one incompleted), stables and an engine house, including laundry, etc.

The 250 children come from different portions of the state to the school, and are there housed, educated, etc., for a period averaging about one year, when they are placed in suitable homes throughout the state.

Diphtheria has been endemic in this school since its establishment in 1887. The occurrence of an outbreak in 1896 and the results of bacteriological investigation were also reported in the former communication above mentioned.

Though the clinical cases became fewer, the persistence of a widespread infection of the throats of the children seemed to be a menace to the health of the school and the state at large, and efforts to prevent this throat to throat infection were made.

The placing of all cases of sore throat and all healthy children whose throats were found to be infected with B. diphtheriæ, in a building, where, as a small isolated colony, they led a separate existence until two successive negative throat examinations showed them clear of diphtheria-like forms, did not prove to be of any avail.

It may be mentioned that one little boy was kept in this building for nineteen months and two days, and that his throat continued to show bacilli of alternating morphology and of virulence for guinea pigs, whenever tested, all this time.

It was therefore felt, owing to the fact that attempts to isolate infected children had proven so ineffective, that half the inmates of a single cottage showed infection, something more radical was demanded. The ground was looked over again most thoroughly and though

examinations of milk, water, earth, etc., yielded negative results so far as the finding of B. diphtheriæ was concerned, toys, etc., showed its presence.

The necessity of sending cultures so far (80 miles) for examination permitted the possibility of these children, whose throats might be germ free at the time of taking, to become infected again from their fellows before the diagnosis could be obtained and acted upon.

Opportunities for infection from child to child were so numerous that the former plans of attempted isolation, etc., were abandoned and the following adopted.

To avoid delay in making and transmitting diagnoses, a bacteriologist's presence was essential, and Dr. McDaniel was placed in charge of a local branch laboratory. The details of the carrying out of this plan have been given on page 465, et seq., of the Biennial Report of the Minnesota State Board of Health, 1897-98, a portion only of which is quoted:

"It was therefore suggested that in one of the buildings a large number of small rooms be constructed, so as to secure absolute individual isolation, and the whole school gradually passed through this filter, as it were, and that the germ-free filtrate be kept absolutely separated in every way from those who had not yet been through the filter and be housed in a freshly sterilized building; that as soon as the clean filtrate became sufficiently large to warrant it, the others or infected children be confined and isolated."

It was successful, and nearly all of the inmates had been passed through the isolation building and the freedom of their noses and throats from diphtheria bacilli established by at least three successive negative results of examination for each, when upon again examining the supposedly germ-free children, who had been housed in freshly sterilized buildings, the percentage of infection was found to be nearly as great as before.

This plan was then abandoned. The fact that it was impossible to subject all the attendants to a similar process of "filtration" and that they were not by reason of special training so keenly alive to the possibilities of reinfection may be offered in explanation of this. It was felt both by the school authorities and the State Board of Health that the most thorough attempt to rid the school of the condition which had so long menaced the public health was obligatory. It is easier now than at the beginning to see the difficulties in the way.

The effects of the isolation, and the thorough looking over to which the children were subjected, as well as the local treatment of nose and throat in ridding them of diphtheria bacilli, had an apparent beneficial effect upon the general health of the school.

SYNOPSIS OF RESULTS OF CULTURAL EXAMINATIONS MADE FROM THE THROATS AND NOSES OF 263 HEALTHY CHILDREN DURING COMPLETE INDIVIDUAL ISOLATION.

In all two hundred and sixty-three children passed through the isolation wards, during the course of which over five thousand examinations were made.

The following are some of the interesting points obtained by an analysis of the records of these examinations:

I. Sixty-six of the children (25 per cent.) showed no diphtheria-like organisms in either *nose* or *throat* at any time during their period of isolation. An average of over six examinations was made for each of these children.

II. In the remaining one hundred and ninety-seven children, the *throat* or *nose*, or both, were found to be infected with some of the "typical"[1] (*i. e.*, granular or irregularly stained forms of bacillus diphtheriæ), or with the "atypical" form of the organism designated in this paper as groups 1 and 2, respectively. (See description of types which precedes Tables A and B.)

After the first examinations of cultures from both nose and throat taken at the same time, on the discovery of either group of B. diphtheriæ in either nose or throat, or both, cultures were usually taken thereafter from the nose alone until its freedom from any form of B. diphtheriæ was established, when synchronous cultures were taken from both nose and throat, as it had been found that the microbes were more persistent in the nose. This was continued until three successive examinations of cultures from both nose and throat (six in all) gave negative results.

The distribution of the bacilli in the infected children in an average of twenty-three examinations each may be expressed by the following tables:

In these tables by "Group I" is meant those forms of bacilli which when found in clinical cases are ordinarily diagnosised as "B. diphtheriæ," and which when tested in pure culture on guinea pigs are usually virulent. It includes the following (illustrated by stained microscopic specimens and by colored charts drawn to scale from stained specimens.)

These type cultures have been obtained from:

(*a*) Ordinary clinical cases;

(*b*) Healthy children.

(1) During complete individual isolation;

(2) Healthy school children.

1 See British Medical Journal, April 16, 1898, "A Preliminary Communication on Bacillus Diphtheriæ and its Variance in a School in which Diphtheria was Endemic."

The ordinary cultures were examined and from them by dilution, violent shaking and subsequent streaking out isolated colonies were obtained. From these, sowings in a similar manner were made. This was repeated from three to fifteen times during a period of from one month to two years. This does not, of course, mean that any colony from which subsequent sowings were made is necessarily developed from an individual bacillus, though the probability is that it is so in many instances.

It must be understood that it is rare except in types D^2 and E^2 for any single type to occur as the sole representative of B. diphtheriæ in direct cultures from nose or throat.

For the interpretation of staining peculiarities it may be mentioned that all cultures were grown on Löffler's serum (containing 1.25 per cent. glycerine) from 18 to 24 hours in the incubator. Specimens are stained with Löffler's methylene blue. This is true of all cultures whether pure or as they were obtained from throats and noses.

Group I.

Type A—1 to 2 microns thick by 3 to 6 microns long; granular or very lightly staining clubbed variety with markedly irregular outlines, i. e., the "ghost," "dumbell," and "clubbed" forms of other observers. Apparently an involution form of B. C. and B^1.

Type B—0.5 to 0.75 microns thick by 3 to 7 microns long; long relatively slender forms which stain lightly except where granules occur at irregular intervals. but more frequently at one pole. The granules (1 to 4 in each bacillus) are ellipsoid and placed with their long diameters lengthwise of the bacillus. Their cross diameter is not greater than that of the rest of the bacillus. They are ordinarily dark blue (showing no trace of red.) This form is not of frequent occurrence.

Type C—0.5 to 1 microns thick by 3 to 4 microns long; often somewhat curved forms in which protoplasm stains light blue except always at poles and occasionally in one point between the poles where rounded, rarely ellipsoid granules occur. These granules stain dark blue with a marked reddish tinge, and are thicker than the rest of the bacillus.

This form is the most common met with in clinical cases, and may perhaps be considered the type of the "long" form of bacillus diphtheriæ as contrasted with the "short" form usually spoken of by most observers.

Type D—0.75 to 1 microns thick by 2 to 3 microns long. Similar in most respects to C., but shorter and thicker and apparently straighter.

Type E—0.5 to 0.75 microns thick by about 1.5 microns long. Otherwise like D. D. and E. comprise probably the "short" forms of bacillus diphtheriæ of other observers.

Type B^1—0.5 microns thick by 3 to 6 microns long; long curved forms usually thicker at one end, or straight forms thicker in the middle with bluntly pointed ends. Its characteristic is a dark blue color with 4 to 8 lightly stained or white transverse bands.

In the experience of this laboratory this form is infrequently met with, though commonly figured in text books, etc.

Type D^1—0.5 to 1 microns thick by 2 to 3 microns long. As compared with B. this form is shorter, has fewer bands and is usually straighter. B^1 and D^1 stain dark blue, and show no reddish tinge as do the granules in C. D. and E.

Type C^2—0.5 to 1. microns thick by 3 to 4 microns long; curved or straight forms usually slightly clubbed or tapering at both ends. Stains a fairly uniform intense blue, no reddish tinge. Infrequently met with.

GROUP II.

Type F—0.25 to 0.5 microns thick by 1 to 2 microns long. Small slender bacilli, with tapering extremities. The bacilli stain light blue and contain one or two rounded granules of an intense dark blue with a reddish tinge. The granules occur at one end or near the middle, or in both places. The granules are thicker than the rest of the protoplasm which tapers from their point of occurrence towards the ends. This form is extremely rare, and its pathogenesis has not yet been tested.

Type G—0.5 to 0.75 microns thick by 1 to 1.5 microns long. Shortest granular form. Bacilli usually paired. Each pair resembles a dark blue ellipsoid divided transversely by a clear narrow space. Granules are very small and occur only at the distal extremities of the pairs. They stain an intense blue, and occasionally show a slight trace of red. Has been very rarely found in clinical cases, though its pathogenesis for guinea pigs has been shown in cultures from a non-clinical case.

Type D^2—0.75 to 1 micron thick by 1 to 2.5 microns long. Bacilli usually in pairs, with opposing extremities flattened and thickened. The distal extremities are bluntly pointed or abruptly rounded. Stain an intense even dark blue. (No reddish tinge.)

This is the type to which particular attention was drawn in a former communication as the "atypical" form of B. diphtheriæ. It is the most prevalent form at Owatonna, is occasionally the only form present in clinical cases, and is frequently pathogenic to guinea pigs, and when so can be immunized against by the use of commercial diphtheria antitoxine. This is the prevailing type of Group II.

Type E^2—0.5 to 0.75 microns thick by 1 to 2 microns long. Very like D^2 except that it is smaller and apparently straighter. D^2 and E^2 are probably included under the "pseudo-diphtheria" group of bacilli of other observers.

Type G^2—0.5 to 0.75 microns thick by 1 to 1.25 microns long. A bacillus resembling D^2 and E^2 in staining and arrangement, but shorter. Has almost diplococcus appearance and resembles G except for the presence of granules.

TABLE A.—(INFECTED CHILDREN.)

No.	THROAT EXAMINATIONS.		NOSE EXAMINATION.		No. of Children	% of Total Infection.
	Variety of Bacillus Present.	When Present.	Variety of Bacillus Present.	When Present.		
1	.....	.....	Group I.....	Throughout.....	21	11
2	Group I	Throughout.....	.....	.....	25	12½
3	.....	.....	Group II.....	Throughout.....	115	58
4	Group II.....	Throughout.....	.....	.....	60	31
5	.....	.....	Both Groups.....	Alternating.....	45	23
6	Both Groups.....	Alternating	.....	.....	33	17
7	.....	.....	Both Groups.....	Concurrent *	9 (4)	5 (2)
8	Both Groups,.....	Concurrent.....	.....	**	3 (1)	1½ (½)
9	Group I.....	Once at least.....	None	Never	5	2½
10	Group II.....	Once at least.....	None	Never	7	3½
11	None.....	Never.	Group I	At least once.....	26	13
12	None.....	Never	Group II.....	At least once †	67 (42)	33 (26)
13	Group I.....	Synchronous at least once.....	Group I.....	Synchronous at least once..... ..	14	7
14	Group II.....	Synchronous at least once.....	.....	Synchronous at least once.....	50	25
15	GroupII(Synchronously with Group I in Nose..	At least once.....	Group I (Synchronously with Group II in Throat)	Synchronous at least once.....	10	5
16	Group I (Synchronously with Group II in Nose.	At least once.....	GroupII(Synchronously with Group I in Throat)	Synchronous at least once.....	7	3½
17	None (Synchronously with Group I in Nose)	.....	Group I (Synchronously with None in Throat)...	.....	25	13
18	None (Synchronously with Group II in Nose)	.....	GroupII(Synchronously with None in Throat)...	.....	97	49
19	Group I (Synchronously with none in Nose)....	.....	None (Synchronously with Group I in Throat)	.....	13	6½
20	GroupII(Synchronously with none in Nose)....	.....	None (Synchronously with GroupII in Throat)	.....	25	13

TABLE B.—(NUMBERS AT MARGIN CORRESPOND WITH TABLE A.)

No.	THROAT EXAMINATIONS.	No. of Cases.	% Infected.	% Free.
2	Group I alone present	25	12½	.....
4	Group II alone present	60	31	.....
6	Alternation of Groups I and II	33	17	.....
8	Concurrence of both Group cases not already included in No. 6 **	1	½	.....
11	Absence of both groups though Group I was present in nose at time of examination	26	.....	13
12	Absence of both groups though Group II was present in nose at time of examination.†	52	.....	26
	Totals	197	61	39
	NOSE EXAMINATIONS.			
1	Group I alone present	21	11	.....
3	Group II alone present	115	58	.....
5	Alternation of Groups I and II	45	23	.....
7	Concurrence of Groups I and II not already included in No. 5.*	4	2	.....
9	Absence of both groups though Group I was present in throat at time examination	5	.....	2½
10	Absence of both groups though Group II was present in throat at time of examination	7	.....	3½
	Totals	197	94	6

FOOT NOTES FOR TABLES A AND B.

* Five of these cases were included in both Nos. 7 and 5, i. e. Concurrence occurred in 2 per cent. not already included in list of Alternations.

** Two of these cases were included in both Nos. 6 and 8, i. e. Concurrence occurred in ½ per cent. not already included in list of Alternations.

† Only 52 cases (26 per cent.) are not already included in No. 11, i. e., in certain cases where both groups were at all time absent from the Nose, there was mixture of the groups in the throat.

As will be seen from the foregoing tables, the bacilli included in group I were found in the throats and noses less frequently than were those included in group II, though present in 11 per cent. of the noses and 12½ per cent. of the throats as the sole diphtheria-like organisms throughout the course of examinations.

The concurrence and alternation of groups I and II, in throats or noses, adds to this number so as to show group I, present in the nose in 38 per cent. of all cases and in the throat of 30 per cent. of all cases.

Group II was present then either alone, mixed or alternating with group I, in the throat in 48½ per cent.

It will thus be seen that noses (94 per cent.) were more frequently found infected than throats (61 per cent.), and that in the nose group II was found nearly twice as frequently as in the throat, whilst group I was nearly as often present in the nose as in the throat. Whether these findings would have been changed by synchronous, and as frequent, examinations of the throat as of the nose, cannot be known, though the results of several hundred examinations had *not* seemed to indicate it.

The members of group II (particularly types D^2 and E^2) seem to be tolerably fixed types of the bacillus, when studied in young serum cultures and stained by Löffler's methylene blue, though they may under certain cultural conditions be replaced by or perhaps changed into bacilli which belong to group I. The opinion expressed in the former communication from this laboratory must be, in this particular, somewhat modified.

This comparative stability of morphology in group II may then account for its much more frequent presence in the children examined, particularly in the noses, though as will have been seen in the throats, the two forms are more even in distribution.

This stability of type in group II is strikingly illustrated by the comparative rarity of concurrence, though alternation (see Tables A and B, items No. 5 to 8) is more frequent, particularly in the throat. In this connection, it must not be forgotten, however, that group I was found alone throughout all examinations more frequently in the throat than in the nose (see Tables A and B, No. 1 and 2), whilst group II, occurred as the sole diphtheria-like organism more frequently in the nose than in the throat (Tables A and B, Nos. 3 and 4), hence it may be inferred that the admixture of group II, from the nose with group I, in the throat, may be facilitated by gravity. The concurrence of forms in either nose or throat was too infrequent to warrant any deductions, which may be also true of the alternations. Gravity, too, and mechanical cleansing, swallowing of foods, drinks, etc., must not

be lost sight of, in considering the more frequent finding of bacillus diphtheriæ in the nose than in the throat.

The more frequent occurrence of one or both groups in the nose of cases whose throats were *diphtheria-bacillus-free* at all times (Table B, Nos. 9 and 10) than was the case in the converse (Table B, Nos. 11 and No. 12) may possibly be explained by the fact that both groups were less often found in the throat than in the nose. Probably more frequent synchronous infection of nose and throat with the same or different groups (See Table A, Nos. 13 to 16) would have been found, had throat examinations been made more frequently throughout the period of isolation, but it will be remembered that as a rule, after the first few examinations, throat cultures were not again taken, until the nose had been found free of all members of both groups, as the nose had shown more frequent infection.

These synchronous findings, either as regards the same or different groups in the nose or in the throat were, of course, included in some previous part of the table. From the frequent temporary disappearance of members of both groups from either nose or throat or more rarely both, met with, and which can be partially estimated from Table A, 13 to 16, it will be seen that had the total examinations been fewer or had the nose been left out of consideration, children would have been sooner, if not more frequently, pronounced "*diphtheria-bacillus-free*," though still infected.

The results given in Table A, Nos. 17 to 20, were compiled only then from cases in which during the course of isolation, in cultures taken at the same time from both throat and nose, it so happened that one place was free of both groups of diphtheria bacilli whilst the other contained one or other of the groups.

WHAT IS THE CAUSE OF THESE HIGH PERCENTAGES OF INFECTION?

The cause perhaps cannot be definitely arrived at, but certain factors which have influenced these almost startling results must not be lost sight of.

First. As stated on a former occasion in this particular institution in which the examinations were made, clinical diphtheria became endemic twelve years ago, and for the last four years has been gradually decreasing until during the whole course of the examinations here recorded, was entirely absent. The earlier cases were graver in type and death or "diphtheritic paralysis" occurred more frequently, but such cases have appeared occasionally, though more rarely in the four years during which this laboratory has carried on investigations in the school.

When clinical cases have occurred, both groups of bacilli have been obtained from their throats, either alone, alternating or mixed, though it was the high percentage of infection in the throats of apparently healthy children which lead to this investigation.

SECOND. The mode of life in the institution, to which reference has already been made, must be considered, whereby many children are brought together, not as in an ordinary school from day to day, but during months, live together, play together, use toys in common, such as whistles, horns, mouthorgans, etc. In children such possibilities of infection cannot be obviated except by actual individual isolation.

THIRD. The frequency of the examinations made would, of course, increase the possibility of finding the bacilli even in throats when it is considered that even in clinical cases, the bacilli are occasionally overlooked.

FOURTH. The taking of nose cultures, throughout, would have the same effect since the diphtheria bacillus was found here more often than in the throat.

FIFTH. The constant supervision of a bacteriologist and the extreme care taken by those who made the cultures who had been especially trained in this for the preceding three years, during which nearly 3,000 examinations had been made, must also be remembered.

SIXTH. The situation of the laboratory in the isolation building with the resulting absence, of necessity, of errors due to transmission of specimens, and the use of perfectly fresh and proper culture medium, (as is not the case where specimens have to be collected and forwarded to the laboratory by physicians), are perhaps important.

SUGGESTIONS CONCERNING THE FREEDOM OF THE CHILDREN FROM SORE THROATS AND OTHER SYMPTOMS WHILST SUCH INFECTION PREVAILED.

FIRST. The virulence of diphtheria has been decreasing, so far as can be ascertained, not only in this institution, but throughout the state during the last ten years.

The type of diphtheria bacillus (D^2), which is most frequently found in the noses and throats of the children in this school, seems to occur rarely in other portions of the state, although it is sometimes met with. Non-granular types of diphtheria-like microbes (E^2 G^2), nearly approximating to it, are very frequent in school children selected haphazard, and particularly so in the child inmates of another somewhat similar institution. (It may be mentioned incidentally that on several occasions from 50 to 100 synchronous throat and nose cultures have given somewhat surprising results in the percentage of typical granular and irregularly staining diphtheria bacilli found, whilst the evenly

staining varieties are still more numerous. Many of these cultures have been isolated in purity and are under investigation, and some of them furnish the cultures and the microscopic specimens on exhibition.)

The comparative stability in morphology, staining reaction, etc., of twenty four hour serum cultures of this (D^2) most common bacillus met with in the children, both before and during isolation, would seem to establish it as a type so far as these characteristics are concerned. These points are important since diagnoses are usually made in laboratories under certain fixed conditions as regards age of culture, kind of medium and method of staining.

It would seem to have less virulence for children, though not devoid of it, as shown in a former communication. (The characteristics of this type have been dwelt upon and proofs of its position amongst types of diphtheria bacilli advanced.) Whether this low degree of virulence for children is as stable a quality as its morphology or not, can only be conjectured and the latter cannot be urged as a proof of the former, though perhaps worthy of some consideration.

Is it not possible that this microbe has become and now remains attenuated through long residence in the throats of the children?

May it not thus immunize them against the other, perhaps for them though not always for animals, more virulent forms of B. diphtheriæ? Certainly as was shown in a former paper, it has the capacity of immunizing laboratory animals against virulent well recognized types of B. diphtheriæ from clinical cases.

Formerly when clinical cases were more numerous, it was observed that the children who had come recently to the school, were most susceptible to sore throats or even marked clinical diphtheria.

The almost universal infection which exists now may have long continued, with this difference, that the bacilli now, through long residence in quasi-normal throats or noses, have been reduced in virulence with the result that typical clinical cases have become less and less frequent.

* * * * * * * * * *

NOTE.—As originally presented this paper was illustrated by numerous stained microscopic specimens, parallel cultures on all the ordinary and sugar containing media, and water color sketches of each of the types described above.

Observations on morphology, biology and pathogenesis of 24 type cultures were given in extended tables.

Through a misunderstanding no provision was made for the publication of the plates and tables in this report, and as a consequence deductions therefrom have also been omitted. This is to be regretted since the chief object of the paper was to furnish a working classification, though purely arbitrary and incomplete as yet, which might be of assistance in recording parallel observations in other laboratories. It is hoped that it may be found possible to present these with later observations at an early date.

BRANCHING DIPHTHERIA BACILLI.

By HIBBERT WINSLOW HILL, M. D.,

Director of the Bacteriological Laboratory of the Boston Board of Health.

Mr. Chairman and Gentlemen—The real object of this brief paper is rather to ask for information than to give it, to suggest a line of investigation rather than to offer results already obtained.

Since Leeuwenhoeck first saw bacteria, more than two hundred years ago, up to the present moment their affinities and classification have furnished material for discussion. One system after another has arisen, waxed and waned, the general trend of advance being towards simplicity of classification based on a growing sense of the real ignorance of fundamentals which still exists even while the knowledge of isolated facts was enormously increased.

Monomorphic extremists gave place to pleomorphic extremists and the pendulum now hangs at a modified pleomorphism and it is sought to allocate aberrant forms with definite species under the general term of varieties. It is impossible to forecast now the doctrines which ten years hence may hold sway, but if one may venture an opinion, it would seem that in bacteriology, as in other natural sciences, the extreme views developed from work along narrow lines are giving way to broader views, including in their scope, it is true, most of the older ideas, but with each of these modified, rearranged and appropriated to the fields which it legitimately covers. Nor is this condition of affairs at all peculiar to the division of botany which deals exclusively with bacteria. A similar gradual modification and rearrangement of ideas on classification is going on amongst those who devote themselves especially to the fungi, the algæ and other allied forms. Perhaps the most marked tendency in modern thought on these matters is that which leads to the recognition of certain of the lower and most aberrant forms as intermediate, developmental or cyclic forms of other higher and better established species. In bacteriology, this tendency is most definite in the bacillus group, heretofore so-called.

It is not necessary to recall to you how the indefinite "ray fungus" of actinomycosis, after various vicissitudes, became classified as a definitely branched form,—a streptothrix. The similarity of the so-called bacillus tuberculosis to the ray fungus in many respects has obtained for the latter recognition as a branched organism, probably also a streptothrix. Already a common parentage for both organisms is

suspected. The organism of leprosy and the organism of glanders also sometimes show branching. The occasional branching of the diphtheria bacillus has been recognized for years. Described at first as a peculiarity, explained as a result of degeneration or involution analogous to, but more advanced than, the well known ordinary aberrations of this peculiar organism, it is now beginning to be recognized as a definite characteristic, and explanations are being sought which shall bring this characteristic into line with those of other organisms having similar peculiarities. In brief, the organism of diphtheria seems likely before long to be removed from the class bacillus and placed in the class streptothrix, as a degenerate form of streptothrix, perhaps. Lachner-Sandoval suggests actinomycetes as a name to include all these branches, the B. diphtheriæ amongst them.

There is little more to be said at present beyond this brief general statement. The fact that branching occurs at times, in fifteen hour cultures as well as in much older cultures, is already established. That it may occur on nutrient agar as well as on Löffler's serum, I have already proved. Perhaps the next most important point is to determine the frequency of its occurrence. The name to be given is a matter of minor importance.

Having observed a number of branching forms, I described them in a preliminary paper in January of this year (Journal Boston Society Medical Science, Vol. III). I found that other men engaged in diphtheria diagnostic work had observed the same branching in their cultures, and still others who had not noted it previously have found them since their attention was called to it. I have followed the simple plan of marking every slide containing branching forms of diphtheria, obtained in the ordinary course of the diagnostic service. At the end of any given period, it is a simple matter to count up the total positive cases and cultures and to find how many of each of these yielded branching forms. It is true that this determines only the percentage of branching on Löffler's serum after fifteen hours' incubation. Nevertheless, this is a valuable point, not only from the theoretical standpoint, but from the practical also. So long as the diagnosis of diphtheria remains largely a matter of the recognition of the peculiar morphology of the diphtheria bacillus, so long will every contribution to the morphology of the bacillus be of practical value. Inasmuch as the diphtheria organism is the only branching organism of its own size likely to be found in the throat, the presence of branching forms of the proper size is a certain although small aid in diagnosis.

I would suggest then, in view of the scientific and practical value of a knowledge of the percentage of cases presenting branched forms, that similar records should be kept in other laboratories for diphtheria

diagnosis and the results published in their reports. There is at present no other organism which is so widely and continuously under observation. It seems a pity not to take advantage of this fact in this way.

Our own results are as follows:

From January 1st, 1898 to October 18th, 1899.

Total positive cultures (Including positive cultures for release.)	1,315
Total branching cultures	71
Percentage	5.4%
Total cases positive	648
Total cases yielding branching forms	64
Percentage	10%

For part of the period, in January, '99, the proportion reached over 50 per cent. Mr. Frederic P. Gorham, Bacteriologist to the Providence, R. I., Health Department, informs me that he found the percentage to be 10.25 of all positive cultures for the period of three months, during which records were kept on this subject. The laboratories of the Providence, R. I., Health Department, of the Massachusetts State Board of Health, and of the Johns Hopkins Hospital, Baltimore, have all isolated pure cultures containing branching diphtheria organisms.

In conclusion, I may add that I had hoped to give a more exhaustive account of the whole subject than is here outlined. Lack of opportunity to add to the material already published anything further of definite value is my only excuse.

A partial list of the articles relating to the general subject of branching bacteria is appended:

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A STREPTOTHRIX FORM ISOLATED FROM WATER AND RESEMBLING THE DIPHTHERIA BACILLUS.

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In the course of the examination of a sample of water from a badly polluted barnyard well, I was struck by the presence in the plates, of a large number of small colonies, which, on examination, proved to be those of a streptothrix. The colonies were small, with fringed margins, and constituted about 75 per cent. of those present, the remaining 25 per cent. belonged to two species of liquefying organisms.

The streptothrix was isolated and its growth followed on all the ordinary laboratory media.

At first the growth was slow, but after several transfers it became more luxuriant until it reached the stage which is indicated in the tubes which I show.

Growth at 37° C. is slightly better than at room temperature, but the difference was not so marked in the early cultures as in those which had been grown for some weeks at 37° C.

At first the growth in glycerine agar and blood serum had many of the streptothrix characters, that is, it grew in disseminated masses which clung to the surface of the medium with considerable tenacity, evidently due to longer filaments penetrating the medium. In later passages, however, this character was not so marked, the growth becoming moister in appearance and being easily swept off the surface of the medium, with the needle.

In the early cultures the microscopic appearance was typically that of a streptothrix, but in older cultures and in young cultures, in the later transfers, the organism showed a tendency to break up into shorter bacillus-like segments in which the branching was not nearly so marked.

As will be seen from the microscopic preparations which I show you, these bacilli presented in the majority of cases a peculiar diphtheria-like appearance. The bacilli were clubbed or irregular in outline, showing when stained with Lœffler's methylen blue the banded and mottled appearance which is seen in diphtheria bacilli. The organism, like all the streptothricacceæ stains by Gram's method. It does not, however, take the Neisser stain.

Its growth on serum and agar is now moist and fairly luxuriant, with a slight tendency to cream color. In bouillon it does not grow well, forming a sediment at the bottom of the tube. It does not fer-

ment lactose or glucose. Its growth on potato is not luxuriant, and on this medium it shows a tendency to break up into shorter segments until it is almost coccus-like in character.

It is only slightly pathogenic for guinea pigs, a serum culture (24 hour) injected subcutaneously into a 250 gramme pig produced an indurated spot, which gradually disappears, from which, after three or four days, a bead of pus can be obtained. I have not completed my examination of its pathogenesis, having animals still under observation.

My reason for presenting a description of this form to the meeting is not because I believe it has any very close affinities to the diphtheria organism, but because from its resemblance, it, to a certain extent, throws light upon the streptothrix affinities of the diphtheria bacillus.

In the literature I find only one organism of similar morphological character described, namely, one described by Wolf and Israel, in Virchow's Arch., Bd. 126. This streptothrix was isolated from cases of human actinomycosis and, although its resemblance to the diphtheria bacillus is not specifically mentioned by the authors, their photographs and descriptions point to strong morphological similarities.

The streptothrix of Wolf and Israel grew better, however, anaerobically than aerobically, whilst this particular organism is more aerobic in character. I have obtained a slight growth in Buchner's anaerobic cultures.

It is possible that there are other streptothricaceæ with similar character if their growth were followed carefully, and I have no doubt that such study would lead us to a better recognition of the affinities of the diphtheria bacillus, as the study of the newer acid proof forms have in working out the affinities of the bacillus of tuberculosis.

DISCUSSION.

Dr. Welch, Baltimore.—As I understand it, there is a question as to the propriety of calling these organisms streptothrix or cladothrix. It is simply claimed that the word "streptothrix" was used years ago for an organism that cannot possibly be put in this group; and you know how much the botanists accuse us of making changes in our nomenclature without any reason whatever—that we use too great freedom in the changing of names already given—and I think there is a great deal of justice in that, and it would be well for medical men engaged in these schools to inform themselves of the proper classification, and not change name unless there was some good reason for it.

Dr. Wesbrook, Minneapolis.—The diagnosis of diphtheria has become such a common thing and is carried out by municipal and other laboratories so frequently, that all people have probably about the same

ideas in regard to what constitutes the diphtheria bacillus. The danger of making the mistake of overlooking a diphtheria bacillus when it is there is extremely small; but in the study of the possible means by which diphtheria may be spread throughout a country or a city, the fact that it remains dormant for a long time and then appears to break out, is one of great importance; and it is perhaps by the study of people who are not at the time infected, though they may be associated with cases, and also the study of apparently healthy children where no epidemic exists at the time, that is to help us in this particular. The difficulty is to know—and especially where there are a great many cultures made—which is diphtheria and which is not. In certain of these we have shown that the bacilli have pathogenic properties, and that by the use of those bacilli we make immunes against other bacilli which are typical, but it is impossible, as I say, to carry this out throughout all cultures which we obtain from all places.

Dr. Hill, Boston.—I wish to ask if the cultures which you got, for instance, would contain practically or entirely type A, another type B, and so on; or whether each culture would have several types mixed?

Dr. Wesbrook.—It is almost impossible to summarize our results. The cultures representing each of those types are given in the tables.

Dr. Ravold, St. Louis.—There is a question I would like to ask, inasmuch as I am a practicing physician and make such examinations occasionally, I have not found the diphtheria bacilli in the nose, as your paper indicates it might be. What is the method of procedure?

Dr. Wesbrook.—We simply thrust the ordinary swab up the nose of the child. I have not said that the granular types were more frequent in the nose; the granular types are more frequent in the throat than in the nose; according to the table, we have the abnormal type down here present more frequently in the nose than in the throat.

Dr. Field, Minneapolis.—I want to ask Dr. Wesbrook if those granules are uniformly blue or reddish in color.

Dr. Wesbrook.—The colorations were made to correspond with the specimens drawn. You will see that in C, D, E and F and probably G there is a sort of a purplish tint; that Q and B are a bluer tint.

NOTES ON BACTERIAL WATER ANALYSIS.

By E. O. JORDAN and E. E. IRONS, Chicago.

A. Transportation.

The change that takes place in the bacterial content of a sample of water removed from a pond or stream is well known. Owing to the rapid multiplication that occurs under the conditions to which the water is usually subjected, the number of bacteria present after even a few hours' standing rarely affords a satisfactory index of the original condition of the water. Multiplication, to an amazing degree, takes place both in water holding a good deal of organic matter and also in water of a high degree of organic purity so that after a few hours or days, original distinctions may be entirely obliterated, and, so far as mere numbers of bacteria are concerned, waters known to be pure and waters known to be polluted come to stand on the same level. The fact is so well recognized that all experienced water analysts insist upon the desirability of plating a sample of water immediately after collection. This injunction, however, is usually coupled with the proviso that if transportation is found necessary the water should be packed in ice, the apparent implication being that at the lower temperature no noteworthy change will take place. It seems to be tacitly assumed by some that a sample packed in ice will arrive at its destination in substantially the same condition as when it was drawn from the source or at least that the procedure will yield fairly uniform results. There are conditions in which these assumptions are not justified, as the following table shows:

TABLE I.

A.			B.		C.	
Temp. °C.		No. Bacteria per Icc.	Temp. °C.	No. Bacteria per Icc.	Temp. °C.	No. Bacteria per Icc.
Immediately after Collection.....	20.75	176	23.5	950,000	29	385,000
After 3 hours.....	9	123	9	510,000	29	.....
" 6 "	6	93	6	90,000	(4 hrs.) 66	130,000
" 11 "	8	87	6	430,000	(8 hrs.) 2	210,000
" 24 "	7	72	7	380,000	(22 hrs.) 6	136,000
" 32 "	8	46	8	340,000	.....	.....
" 49 "	4	27	2.5	429,000	(46 hrs.) 8	305,000
" 72 "	1	39	3.5	480,000	.....	.....

A similar decline appears sometimes with striking distinctness in the course of practical work. In one instance that we had special reason for noting, three samples of polluted river water of a temperature of about 28° C. were plated immediately after collection and gave respectively 535,000, 412,000 and 329,000. The bottles were at once packed in ice by the usual method and shipped to Chicago. Owing to delay in transmission they did not arrive until 48 hours had elapsed; the ice had then melted and the temperature of the water in the outer case was 21°, but in spite of this comparatively high temperature the numbers obtained by plating—namely, 54,500, 50,500 and 73,500—were much lower than the initial numbers. There is no escape from the conclusion, therefore, that in some cases packing in ice is followed by a rapid and marked decline in the number of colonies that develop when the water is plated with the ordinary culture media. Whether this is due to an actual destruction of bacterial life or to a simple weakening of certain cells which renders them incapable of development in the media used is a question of subordinate importance to which we have at present no answer.

It sometimes occurs, on the other hand, that instead of a decline in numbers in water samples packed in ice a considerable increase may be observed.

TABLE II.

A.			B.		C.	
Temp. °C.		No. Bacteria per 1cc.	Temp. °C.	No. Bacteria per 1cc.	Temp. °C.	No. Bacteria per 1cc.
Immediately after Collection.....	15.5	102	16	1,130,000	16	1,240,000
After 5 hours.....	2.5	87	5.5	1,190,000	2.5	1,450,000
" 26 "	8	990	7.5	1,720,000	(18 hrs.) 5.5	1,370,000
" 50 "	6	1,150	4.0	.....	(29 hrs.) 2	2,690,000

The most plausible explanation of the difference in behavior between the waters in Table I and Table II is that the initial temperature determines to a large extent the course of events. The shock produced by suddenly chilling the living cell from 28° to 6° or 7° must be greater than that caused by a change of only ten or twelve degrees. In the warmer seasons of the year, therefore, the vitiation of numerical results by transportation probably reaches its maximum whether the water sample be shipped without any attempt to modify its temperature or whether it be packed in ice. It must not be forgotten, however, that the lowering of numbers caused by packing in ice has its limits, and

that a badly polluted water is not under ordinary conditions depressed to the level of a pure water (Cf. A, B and C, Table I). It is well known that such is not the case with the multiplication that takes place in water allowed to stand at the room temperature: the number of germs in a pure water may in a short time equal that in a polluted water. Of the two evils, then, the lesser is the method of ice-packing, but the considerable error involved in this method under certain conditions should not be longer ignored, and it should be recognized that numerical results obtained upon water samples transported in this way possess at best merely a relative value, and that unless the initial temperature of the water be known no safe comparison can be made between results obtained at different seasons of the year.

The influence of ice-packing upon such colon bacilli as may be present in polluted water does not appear to be injurious. We have not been able to observe any marked disappearance of B. coli, either in ice-packed waters or in those maintained at a higher temperature, during a period such as might ordinarily elapse during transportation. The following experiment may be taken for illustration:

TABLE III.

Temp. °C.	B. coli present in 1-1000 cc.	Temp. °C.	B. coli present in 1-1000 cc.
Imm. after Coll..... 16	+	16	+
After 5 hours..... 2.5	+	16.5	+
" 18 " 5.5	+	15.5	+
" 29 " 2	+	17	+

The question of the possible multiplication of B. coli in water not packed in ice is one that we are still considering.

B. Dilution.

It is generally admitted that the count of bacteria on a plate is seriously interfered with if the colonies are very numerous, not only through the mechanical difficulties of enumeration, but also because of the possible overgrowth or inhibition of certain delicate or slow growing species by more robust associates. For these reasons it has been a common practice in dealing with waters suspected of harboring many germs either to use a fractional part of a cubic centimeter or to dilute the water to the desired extent and plate one cubic centimeter direct from the dilution. So far as we are aware, however, no uniform method of dilution has governed procedures of this character. It is not altogether a matter of indifference whether a fractional part of a

cubic centimeter be plated or whether a dilution with sterile water be made. The former manipulation is perhaps more likely to involve error, and it is true that results obtained by plating 1-10 cc., for example, will be found to agree less closely with one another than those obtained from a 1-10 dilution with sterile water.

A more serious difficulty is connected, however, with the suppression or obscuration of colonies. If there are more than about 100 colonies to the plate this source of error may become considerable. The point can be most easily illustrated by citing some figures obtained in actual practice. The results obtained are averages from duplicate counts which agree closely.

TABLE IV.

A.		B.	
Undiluted	218	Diluted 1-1000	844,000
Diluted 1-10	470	Diluted 1-10000	2,630,000
		Diluted 1-100000	4,300,000
C.		**D.**	
Undiluted	1,500	Diluted 1-1000	479,000
Diluted 1-10	4,340	Diluted 1-10000	1,120,000
Diluted 1-100	8,800	Diluted 1-100000	1,300,000

In contrast with this may be placed results obtained when the colonies are less numerous.

TABLE V.

A.		B.	
Undiluted	85	Undiluted	27
Diluted 1-10	110	Diluted 1-10	20
C.		**D.**	
Undiluted	42	Diluted 1-10000	1,470,000
Diluted 1-10	50	Diluted 1-100000	1,500,000
Diluted 1-100	sterile		

We believe it safe to recommend, therefore, that a degree of dilution be practiced which will result in the appearance of not more than 100-150 colonies on each plate. When the average range of a water is not known dilutions should be prepared which will cover possible contingencies.

We are prepared for the objection that the somewhat extreme dilution here indicated for some samples of water leads to exaggeration of certain unavoidable errors of technique such as the occasional occurrence of colonies arising from air contamination, but we are confident

that in actual practice this objection will be found to weigh but little (Cf. B and C, Table V), while the added gain in precision of enumeration as well as the avoidance of inhibition will infallibly lead to results more strictly comparable than any obtained by hit-or-miss methods of dilution.

C. Nutrient Media.

The vexed question of the most suitable medium for plating samples of water is one which most laboratory workers have sooner or later to face. The adoption of a uniform reaction, as suggested by Fuller, is a notable advance and has rendered in some degree comparable the results obtained in different laboratories. In our examination of river waters we have obtained on the average higher counts with the + 10 reaction on Fuller's scale than with the + 15. In this connection we may state that we indorse heartily the suggestion of Theobald Smith (Journ. Expt. Med., IV., 1897, p. 380), that the minus sign is in every way the more suitable designation for the acid reaction to phenolphthalein, and we should be glad to witness its general adoption.

Far more important, however, than the exact reaction of the medium are other factors that have as yet been incompletely studied. Variations in the compositions of the peptones used have been shown to be of great significance, and Prof. Sedgwick (Report American Public Health Association, XX., 1895, p. 450), in an important paper before the American Public Health Association in 1895, called attention to the superior nutritive value of a preparation known commercially as somatose. Quite recently a paper by Hesse and Niedner (Zeitschr. f. Hyg., XXIX., p. 454), has appeared in which a substance composed largely of albumose and known by the trade name of Nährstoff Heyden is recommended as a bacterial nutrient. We have recently procured some of this substance and have obtained with it numerical results so much higher than those secured with the ordinary nutrient media that we have thought a brief record of the facts might be of general interest, although we are compelled to reserve a full discussion of the matter for a subsequent communication.

TABLE VI.

1 *Surface Water* (*Lake Michigan*).

	Reaction (Fuller's scale).	No. of Colonies 8 days.
Ordinary Witte's peptone agar	+10	50
Ordinary Witte's peptone gelatin	+10	130
Somatose gelatin (no broth)	0	110
Nährstoff Heyden gelatin (no broth)	0	460
Somatose agar (no broth)	0	470
*Nährstoff Heyden agar (no broth)	0	570

2 *Surface Water* (*Mississippi River*).

	Reaction (Fuller's scale).	No. of Colonies 7 days.
Ordinary Witte's peptone agar	10	206
Somatose agar (no broth)	0	543
*Nährstoff Heyden agar (no broth)	0	612

3 *Sewage* (*diluted* 1-10000.)

	Reaction (Fuller's scale).	No. of Colonies 10 days.
Witte's peptone agar	10	127 127
Somatose agar	0	198
*Nährstoff Heyden agar	0	355 342

4 *Ground Water* (*Artesian Well.*)

	Reaction (Fuller's scale).	No. of Colonies 9 days.
Ordinary Witte's peptone agar	10	15
Ordinary Witte's peptone gelatin	10	21
Nährstoff Heyden gelatin	0	700
Somatose agar	0	584
*Nährstoff Heyden agar	0	920

* Prepared according to the formula given by Hesse and Niedner, viz :

Agar-agar	1.25%
Albumose (Nährstoff Heyden)	0.75%
Distilled Water	98.00%

The ease and rapidity with which this medium can be prepared is no small point in its favor.

THE SIGNIFICANCE OF CERTAIN GAS-PRODUCING BACTERIA OF NON-COLON TYPE IN SANITARY WATER ANALYSIS.

By H. L. RUSSELL and V. H. BASSETT, Madison, Wis.

The sanitary analysis of water is beset with numerous difficulties, among which from a biological point of view the most important is to determine the significance of the various species of bacteria that are to be found in the same.

Without entering into the question as to whether the common fecal organism, B. coli communis, is to be regarded as an index of fecal pollution or not, there is no doubt but that the presence or absence of this particular microbe is of more than ordinary importance in determining the character of the supply.

This being true, considerable attention has been paid by sanitary bacteriologists to the method of isolation of this organism. These methods for the most part involve the use of media that permit of the more rapid development of the colon organism and its congeners in comparison with the normal water flora.

Among the characteristics of the most common fecal organism is the power to ferment various sugars as glucose, lactose, and saccharose. As Theobald Smith has pointed out, the formation of gas in different sugars follows certain tolerably well defined laws, a recognition of which enables the colon germ to be fairly well differentiated from other similar species.

But the function of gas production is one that is so widely distributed among various fermentative bacteria that care must be taken in estimating its significance in water analysis. While it marks a salient characteristic of the most typical fecal organism that differentiates it from the typhoid bacillus, still the group of gas-producing bacilli that are to be frequently found in water is so abundant that the mere ability to ferment sugars can not in itself be regarded as signifying the presence of the colon organism.

If the aerogenic organisms that are not infrequently found in various water supplies are studied in their relation to each other, it will at once be evident that a differentiation is possible even on the basis of the gas production.

ISOLATION OF GAS-PRODUCING BACTERIA.

To insure the elimination of other species that are cultivable at blood heat, it is better to isolate in pure culture the gas-forming species, in

order to produce accuracy of results. This can easily be done in a variety of ways. The method most frequently employed by us is to make a litmus lactose agar culture of a sample of water, and if acid colonies develop, transfer these at once to glucose fermentation tubes, preserving stock cultures on agar for future study if needed. Often the gas-producing species can be readily isolated from a fermentation tube. For this purpose a young culture is preferable, as the acid-producing species is not infrequently killed out by virtue of the acid which it forms itself. For isolation, pour a litmus lactose agar plate and after same is hardened transfer by means of a needle from fermenting sugar tube to agar plate, making several streaks. The preponderance of colonies that will develop on plate will generally be acid, if taken from an actively fermenting culture, and it is usually an easy matter to isolate from these streaks distinct colonies that serve as a basis for preparation of pure cultures. The complete separation of the more common gas-producing species does not usually require more than 36 hours, and from the separated colony on the litmus agar, a glucose-free broth culture is made for indol test. Fermentation tests in glucose and lactose bouillon, litmus milk, and gelatin stabs are made. These five sub-cultures will permit of a differentiation that will define the colon affinities of the germ in about two to three days more.

Of leading importance in this differentiation is the character of the fermentation in different sugars; not so much as to the amount and rate of production of the gas in the different sugar solutions as the relation of the gases to each other.

Where gas is produced as a result of the fermentation of these carbohydrates, it is a mixture of at least two different kinds, CO_2 and an explosive residue that is generally H. The relation of these gases to each other in many species of aerogenic bacteria is fairly constant. Theobald Smith has given prominence to this matter in connection with colon and allied forms, and has designated this relation of $\frac{H}{CO_2}$ as the gas formula.

The characteristic relation for the colon type of organism has been shown by him as well as others to be $\frac{H}{CO_2}=\frac{2}{1}$

Of course, there is some fluctuation from this proportion, but under uniform conditions and where properly determined, the constancy of this relation is strikingly apparent. The classification on the basis of their gas formulæ of many of the aerogenic forms found in water supplies shows at once two well differentiated groups.

1. Those having a formula of 2-1 as represented by the colon bacillus.

2. Those having an inverted formula of 1-2.

These two classes are often represented, the first one in those waters that are polluted with fecal discharges; the second in open waters in which the possibility of sewagic pollution is not absolutely prevented, but in which the more probable origin of the gas-forming organisms is from upper soil layers or decomposing vegetable or possibly animal matter.

It must be borne in mind that in addition to these two groups first mentioned, transitional types are also more or less frequent. Sometimes the gas formula exceeds 2-1; then again, the amount of hydrogen practically equals that of CO_2, making the formula 1-1. These forms are less frequent, but have been isolated occasionally. Their significance, however, has not as yet been determined by us definitely. A continued study of a large number of these gas-forming bacteria from water leads us to believe that some types of these groups are subject to considerable variation when cultivated on artificial media for a length of time. In our experience this tendency to variation has expressed itself mainly in the fermentative function, more especially as to the amount of gas produced, although considerable change in gas formula has also been noted. This has been more apparent in the 1-2 and in the transitional or 1-1 type than it has in the distinctly colon class. The 1-2 group seem to be the most variable in its gas relationship, the 1-1 group varying in time but more slowly.

While an inspection of the gas formula of those types in which the H is equal to or less than CO_2 at once serves to differentiate them from the colon type, those species possessing the formula 2-1 or thereabouts can not safely be classed as colon on this basis alone. In this case, the other cultures aid in determining colon affinities. Of most value is the growth in gelatin stabs and the indol test in glucose-free meat broth. The absence of a positive indol reaction is of less value than other characteristics, for the reason that this is sometimes delayed until the culture is several days old, and again, for the reason, as Dr. Peckham has shown, that genuine coli cultures do not always form indol. The determination of the gas formula then is of prime importance in determining the relations of any aerogenic organism. While it cannot settle the question positively whether an organism is colon-like or not, the presence of an aberrant colon formula as 1-1, or more specially 1-2, signifies the non-colon relation of the germ.

The significance of this type in water, we believe, can be understood fairly well, at least in its general relations. In the first place, species possessing this inverted formula 1-2, are not common in the fecal discharges of different animals. An examination made in this laboratory by one of the graduate students, Mr. E. B. Hoag, of the feces of a considerable number of different species of mammalia, as well as that

of birds, fish, etc., showed that the 2-1 gas formers were the predominant species in intestinal contents and discharges. In fact, in his observations, he failed to note the presence of the 1-2 type.

In classifying the waters from which the majority of these 1-2 organisms were isolated, it is noteworthy that they are not infrequently found in municipal supplies under conditions where fecal pollution is quite improbable.

Moreover a study of organic matter undergoing decomposition under circumstances where the probability of coli contamination was very slight, so far as they might be derived from fecal sources, shows that this type of bacterial growth is frequently associated with these processes.

Vegetable mold from the forest, rotting leaves, and tree trunks have been found to harbor gas formers of this class. Whether they are also widely distributed in the upper soil layers has not yet been ascertained with certainty. The abundance of humus in many soils undergoing decomposition changes would probably give conditions favorable to this group as well as others, so it may be reasonably certain that they will be found represented among the soil bacteria.

CONCLUSION.

(1) The most important point in the differentiation of gas-producing bacteria is the determination of the gas formula. This has been found to be more constant than the amount of gas produced and is therefore of more differential value.

(2) In the fecal type of bacteria the relation of the H to CO_2 is generally as 2:1. Very frequently organisms producing gas having an inverted formula (1-2) are to be found in water supplies.

(3) While the presence of aerogenic bacteria having a gas formula of 1-2 or thereabouts can not be regarded as an index of fecal pollution, or even as indicating probable presence of colon type, still the determination of these forms in a water supply should receive attention. Their presence should be satisfactorily explained. If they come from an open surface supply, their presence is not so important as if they originate from a subterranean source, for our present knowledge leads to the opinion that they are species that are associated with the decomposition of organic matter and that they are to be found in connection with such changes or possibly in the upper soil layers.

ON THE QUESTION OF STANDARD METHODS FOR THE DETERMINATION OF THE NUMBERS OF BACTERIA IN WATERS.

By GEORGE W. FULLER and GEORGE A. JOHNSON.

In the development of methods of purification of water and sewage and the laws pertaining thereto, the value derived from determinations of the numbers of bacteria has been great. In a measure this has been true also in the case of studies and comparisons of waters in their natural condition; but, of course, the sanitary character of water supplies in many cases is shown more definitely by data upon the presence of bacteria of the colon group, than by records of the numbers of bacteria.

At present many sanitary problems of a bacteriological nature require for their solution specific data obtained from actual study of the local conditions; but, after some fifteen years of experience in the application of bacteriology to sanitary problems in different countries, the time has arrived when the logic of the situation demands that much reliance be placed upon the results of the past as to guidance in future work.

In studying the evidence now available, with the view to formulating the underlying principles of many lines of applied bacteriology in connection with the numbers of bacteria, one is impressed with the fact that in many instances the results from different places are not strictly comparable with each other. In a measure it is possible in some cases to translate one of several sets of results, with the aid of more or less accurate factors, so that they may be fairly comparable with those obtained from another source.

The existing limitations, with reference to the value which can be safely derived from the quantitative bacterial results in general, are, of course, due to divergent methods used in obtaining the analytical results.

These limitations are felt, not only in the comparison of the bacterial contents of various natural waters, but it is now being realized more clearly in connection with purification plants, where the residual numbers of bacteria in the effluents are beginning to receive the attention which they deserve, in conjunction with the efficiency of purification as expressed in percentages.

To illustrate this condition of affairs by what would be the most extreme cases, attention may be called to the dilution methods of the French school of bacteriologists, who employ at times liquid culture

media, and who use a period of cultivation sometimes extending to even several weeks, and to the official German methods in which a solid culture medium is employed, in connection with a period of development of two days at 20 degrees C. It is a difficult matter to state precisely how these different methods of analysis affect the determination of the numbers of bacteria in water, but it is safe to say that in many cases the individuality of a sample of water would be lost, so far as could be learned by comparing the analytical results obtained by these two methods.

In the case of work of this class which has been done in America, the results, almost without exception, have been obtained by methods which in some respects might be called intermediate between the French and German methods, but which yield results corresponding much more closely to the German results. The methods employed by the different bacteriologists in America for determining the numbers of bacteria fall far short of a standard procedure. In a general way they represent on an average, so far as can be learned, something in the vicinity of 85 per cent. of the total numbers of bacteria which are capable of developing on the conventional nutrient gelatine. That is to say, in the more important pieces of work in this country, the period of development under given conditions has apparently been such that the final counts of the numbers of bacteria have been made at a time when further incubation would not, as a rule, have yielded an increase of more than about 15 per cent. of the numbers actually recorded.

Comparing the American with the German methods for determining the numbers of bacteria in water, we are led to the conclusion, as the result of our studies on the subject, that the German results, as a rule, represent about 55 per cent. of the numbers of bacteria which are capable of development in the conventional nutrient gelatine, and about 65 per cent. of the numbers which are obtained by the ordinary American methods of analysis. It is to be understood, of course, that these comparisons are to be taken in general terms, and it is very likely that there may be many important instances wherein the figures above stated depart materially from the facts. It is believed, however, that on an average they are not wide of the mark, as judged by the evidence now available, and that they serve their present purpose in a reasonably satisfactory manner. It is hardly necessary to state that it is the longer period of development used in the American methods which causes the American results to be materially higher than those obtained by German bacteriologists.

In considering the question of the numbers of bacteria in water there are several factors to be kept in mind. In the first place, all results of this nature are dependent for their value upon their relative, and not

their absolute, accuracy, because there are many bacteria in water which are incapable of development upon the media ordinarily employed. This being true, it will be appreciated that it is very necessary, in order that full value may be derived from analytical results of this class, that they should be obtained by methods yielding fairly comparable results in the hands of all workers.

From a utilitarian standpoint it is further to be remembered that in many instances the practical value of the results is enhanced, as the period required to obtain the analytical evidence is shortened.

Enough has been said to show in general terms a condition of affairs which, to the thought of the writers, needs improvement, and one which apparently is a fitting subject for consideration by the Laboratory Committee of the American Public Health Association.

Without elaborating to a further degree the shortcomings of laboratory methods, which have been very important contributors to the advancement of sanitary science, and without burdening our hearers with detailed information with which they are thoroughly familiar, we desire to bring out, for the purpose of discussion, several points in connection with this general topic, as follows:

I.

In order to enhance the value of quantitative bacterial results there is no doubt of the desirability of making it a uniform standard practice to record in connection with all such results the conditions under which they were obtained; and we would respectfully call the attention of the Laboratory Committee to the advisability of the universal adoption of this custom.

The points upon which information is more especially required are the following: Composition of culture medium; reaction of the medium; dilution of sample of water, if such be made; and the period and temperature of development.

II.

There are good grounds for believing that the bacterial contents of various waters and sewages, obtained under widely different natural conditions, present a quite well defined individuality when subjected to the same methods for the determination of the numbers of bacteria.

Perhaps the most important ways in which waters will show their respective individualities at different times is with reference to the reaction of the culture medium, and to the period required for the development of the colonies. With opportunities for widely different life histories of the bacteria, prior to the analysis of the water in which they are contained, it is not unnatural to suppose that this is a factor of some

importance in many instances. To learn how great a factor it may be, it is very much to be desired that information be obtained with reference to what may be called the individuality of the bacteria as explained above.

To illustrate the significance of this point, it may be stated that experience has shown that in the study of the bacterial contents of the Ohio River water, the optimum reaction of the medium ordinarily was nearer 1.0 per cent. than 2.0 per cent., as was found to be the case at Lawrence. Further, it is well known that the bacteria in water from some sources develop much more slowly than in other cases when subjected to exactly the same laboratory treatment.

A wide range of data along this line is required not only to establish the permanent value of current work, but also to pave the way ultimately for standard methods.

III.

With a view to obtaining as complete development of water bacteria, and in a shorter time than is now the case, studies have been made by the writers of various modifications of current methods. Of a number of such procedures which have been tried, the most promising results have been obtained by the use of a simple medium, consisting of ordinary meat infusion with 1½ per cent. by weight of gelatine. It would appear from our studies that the omission of peptone and salt enables a medium to be obtained of higher nutritive value than is now the case. The explanation of this appears to be that it prevents elimination of many of the nutritive constituents by precipitation. In the preparation of this medium especial care is required that it shall not be overheated.

It has been our custom in preparing this medium to heat the meat infusion over a steam bath, and bring it to a point where coagulation just begins, usually requiring about eight to ten minutes. The gelatine is then added, and as soon as it is dissolved the mixture is titrated and neutralized. It is next placed over a free flame and allowed to remain until it comes to a *sharp boil*, the mixture being carefully stirred in the meanwhile. Following this, it is filtered through absorbent cotton or filter paper, and the reaction adjusted to the desired point. After solidification the medium is autoclaved once for ten minutes at a pressure of fifteen pounds. In order to avoid serious complication from liquefaction, it is very necessary that the amount of heating be as small as possible, and in conformity with the directions above stated.

In repeated instances at Louisville and at Cincinnati this medium yielded results in two days' development at 20 degrees C., which are at least 50 per cent. higher than those obtained from the regular nutrient gelatine after a period of three days' development at the same temperature.

A summary of these results is presented in the following table:

NUMBERS OF BACTERIA PER CUBIC CENTIMETER.

Reaction (per cent.)	Regular Nutrient Gelatine.	Meat Infusion and Gelatine.
0.0	110	200
0.5	110	210
1.0	120	160
1.5	80	130
2.0	75	70

It is instructive to note that the optimum reaction was found to lie nearer to the neutral point, in the case of this modified medium, than in the case of the regular nutrient gelatine. Another point worth mentioning is that it is inadvisable to use less than ten cubic centimeters of this medium for each plate, as a smaller quantity apparently facilitates liquefaction.

The present evidence obtained from the use of this modified medium indicates that it is worth while to investigate it in different laboratories, in view of the fact that it not only yields more complete results but also enables them to be obtained more quickly than is the case with the present medium.

IV.

In recording the results of quantitative bacterial examinations, the records show that in many instances the results are expressed in numbers which contain characteristic figures considerably beyond the limits that the accuracy of the methods warrant. It is not unusual to see characteristic figures in the units column, in cases where the numbers of bacteria per cubic centimeter are found to be 1000, and even much greater than that. As the methods of analysis are accurate to within not less than 5 per cent., to put the figure very low, this custom involves fictitious accuracy to an unfortunate degree, and there are good grounds for believeing that it is a great factor in retarding proper value being placed upon bacterial data by workers along other lines of sanitary science.

To devise a simple procedure which shall be uniformly consistent from a strictly mathematical standpoint is a difficult matter. At Cin-

cinnati the writers adopted a scheme which is undoubtedly a step in the right direction, and which is as follows:

Number of Bacteria per Cubic Centimeter.	Recorded to
1— 50	Nearest unit.
51— 100	" five.
101— 250	" ten.
251— 500	" twenty-five.
501—1,000	" fifty.
1,001 and over	" hundred.

It seems especially desirable that there should be adopted a uniform practice in this respect by the various bacteriological workers, and it is a point which could apparently be much improved upon if taken under consideration by this committee.

SOME POINTS ON THE DIFFERENTIATION AND CLASSIFICATION OF WATER BACTERIA.

By GEORGE W. FULLER and GEORGE A. JOHNSON.

From a practical standpoint the value of species differentiation, as applied to water bacteria, lies chiefly in the aid derived from its results in formulating prompt and reliable methods for the detection of bacteria associated with disease.

To facilitate the isolation of disease germs in water, it is desirable to increase our general knowledge of the bacterial flora of waters.

It is not the purpose of the writers to review the current evidence and status of the subject, but rather to offer for discussion a few of the leading points which were learned during some bacteriological investigations undertaken by the writers in connection with the Cincinnati water supply.

The more important results of these studies have been recorded at some length in an article, "On the Differentiation and Classification of Water Bacteria," which is to appear in a forthcoming number of the Journal of Experimental Medicine. Through the kind permission of Dr. Welch we are permitted to make use of the subject matter of that paper, in connection with the following points which are presented for the purpose of discussion.

I.

CONDITIONS OF CULTIVATION OF BACTERIA FOR SPECIES DIFFERENTIATION.

This subject involves the consideration of the following points, which will be briefly discussed in order:

1. Vitality of the organism at time of cultivation for classification data.
2. Composition and preparation of culture media.
3. Temperature of cultivation.
4. Period of cultivation.

1. Experience shows that in many cases two members of the same species of water bacteria, isolated under and subjected to parallel laboratory conditions, will differ in some specific functions or characters, according to present methods. When we consider how variable may be the life histories of bacteria of the same species when isolated from water, it is not unnatural to expect that there should be notable variations in their characters as revealed in the laboratory. For instance,

NAME OF ORGANISM.	First Investigator.	Morphology.				Cultural Featu				
						Nutrient Broth Tube		Nutrient Agar Tube.		Gelatin Plate.
		Bacillus.	Diameter Greater than 1 re.	Motile.	Spores.	Scum.	Turbid.	Dull.	Wrinkled.	Characteristic appearance.
						Group I.				Flu
B. Fluorescens Liquefaciens	Flügge	+	—	+	—	+	+	—	—	+
B. Fluorescens Non-Liquefaciens	Eisenberg	+	—	—	—	+	+	—	—	—
B. Viridis	Lesage	+	—	+	—	+	+	—	—	+
B. Fluorescens Ovalis	Ravenel.	+	—	+	—	+	+	—	—	—
B. Pyocyaneus	Gessard	+	—	+	—	+	+	—	—	+
B. Fluorescens Incognito	Wright	+	—	+	—	+	+	—	—	—
						Group II.				Chrom
B. Prodigiosus	Ehrenberg	+	—	+	—	+	+	—	—	+
B. Rubidus	Eisenberg	+	—	+	—	+	+	—	—	+
						Group III.				Chromo
B. Arborescens	Frankland	+	—	+	—	—	+	—	—	+
B. Aurescens	Ravenel	+	—	+	—	—	+	—	—	—
B. Fulvus	Zimmermann	+	—	—	—	—	+	—	+	+
B. Fuscus	Zimmermann	+	—	—	—	—	+	—	—	—
B. Aurantiacus	Frankland	+	—	+	—	—	+	—	—	+
						Group IV.				Chromo
B. Desidious	Wright	+	—	—	—	+	+	—	—	—
B. Ocraceus	Zimmermann	+	+	+	+	—	—	—	+	—
B. Flavescens	Pohl	+	—	+	—	—	+	—	—	—
B. Lactis Erythrogenes	Hüppe	+	—	—	—	+	+	—	+	+
B. Subflavus	Zimmermann	+	—	+	—	—	+	—	—	—
Sarcina Lutea	Schröter	—	—	—	—	—	—	—	—	+
						Group V.				Chromo
B. Janthinus	Zopf	+	—	+	—	+	+	—	+	+
B. Violaceus	Frankland	+	—	+	—	+	+	—	—	+
						Group VI.				
B. Mycoides	Flügge	+	+	+	+	+	—	+	—	+
B. Mesentericus Vulgatus	Eisenberg	+	+	+	+	+	+	—	+	+
B. Proteus Fluorescens	Jäger	+	—	+	—	+	+	+	—	+
						Group VII.				
B. Subtilis	Ehrenberg	+	+	+	+	+	—	+	+	+
B. Cereus	Frankland	+	+	+	+	+	+	+	+	+
						Group VIII.				C
B. Cloacae	Jordan	+	—	+	—	+	+	—	—	—
B. Liquefaciens	Eisenberg	+	—	—	—	—	+	—	—	—
						Group IX.				liq
B. Liquidus	Frankland	+	—	+	—	—	—	—	—	—
B. Antenniformis	Ravenel	+	—	+	—	+	—	—	—	—
						Group X.				Sp
B. Superficialis	Jordan	+	—	+	—	+	+	—	—	—
B. Annulatus	Wright	+	—	+	—	—	+	—	—	—
B. Flexuosus	Wright	+	—	—	—	+	+	—	—	—
B. Geniculatus	Wright	+	—	+	—	+	+	—	—	—
B. Aquatilis Communis	Zimmermann	+	—	+	—	+	+	—	—	—
						Group XI				C
B. Coli Communis	Escherich	+	—	+	—	+	+	—	—	—
B. Aerogenes	Escherich	+	—	—	—	+	+	—	—	—
						Group XII.				Ty
B. Simultyphus	Eberth	+	—	+	—	+	+	—	—	—
B. Solitarius	Ravenel	+	—	+	—	+	+	—	—	—
B. Aquatilis Sulcatus I	Weichelbaum	+	—	+	—	—	+	—	—	—
B. Aquatilis Sulcatus V	Weichelbaum	+	—	+	—	—	+	—	—	—
						Group XIII.				Ca
B. Candicans	Frankland	+	—	+	—	—	+	—	—	—

BIOLOGY.

Biochemical Features.															Pathogenesis.
Fermentation Tube.	Luxuriant.	Growth in Closed Arm.	Grows at Body Temperature.	Facultative Anaerobe.	Affected by Range of Reaction.	Liquefaction. Gelatine.	Liquefaction. Casein.	Liquefaction. Blood Serum.	Gas Production. Dextrose Broth.	Nitrate Reduced.	Indol Reduced.	Milk Coagulated.	Fecal Odor.	Nutrient Agar Tube. Chromogenesis.	Nutrient Agar Tube. Fluorescence.	White Mice. Intraperitoneal Inoculation Fatal.
...nscent Type.																
—	—	—	—	—	+	+	+	+	—	+	—	+	—	—	+	—
—	—	—	—	—	+	—	—	—	—	—	—	—	—	—	+	—
+	+	+	+	+	+	+	+	+	—	+	+	+	+	—	+	+
+	+	+	+	+	+	—	—	—	—	—	—	—	—	—	+	—
+	+	+	+	+	+	+	+	+	+	+	—	+	+	—	+	+
+	—	+	+	—	+	—	—	—	—	—	—	—	—	—	+	—
...enic Type—Red.																
+	+	+	+	+	+	+	+	+	+	+	—	+	—	Crimson	—	—
—	+	—	—	+	+	—	—	—	—	—	—	—	—	Brick Red	—	—
...gic Type—Orange.																
+	—	—	—	+	+	+	—	—	—	—	—	+	—	Orange	—	—
—	—	+	—	+	+	+	+	—	—	—	—	+	—	"	—	—
—	+	—	+	+	+	—	—	—	—	—	—	—	—	"	—	—
—	+	+	+	+	—	—	—	—	—	—	—	—	—	"	—	—
—	—	—	—	+	—	—	—	—	+	—	—	—	—	"	—	—
...onic Type—Yellow.																
+	—	—	—	+	+	+	+	—	—	—	—	+	—	Yellow	—	—
—	—	+	—	+	+	—	+	—	+	—	—	+	—	"	—	—
+	+	—	+	+	—	—	—	—	+	—	—	—	—	"	—	—
+	—	—	—	+	+	+	+	—	+	—	—	+	—	"	Pink	—
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—	+	+	+	+	+	—	—	—	—	—	—	—	—	"	—	—
...onic Type—Violet.																
+	—	—	—	+	+	+	+	—	+	—	—	+	—	Dark Violet	—	—
+	—	—	—	+	+	+	+	—	+	—	+	—	—	Violet	—	—
...iteus Type.																
+	+	+	+	+	+	+	+	+	—	+	—	+	—	—	—	—
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...loacae Type.																
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...luidus Type.																
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...rficialis Type.																
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—	—	—	—	—	+	+	—	—	—	+	—	—	—	—	—	—
...olon Type.																
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...yphosus Type.																
—	—	+	+	+	+	—	—	—	—	+	—	—	+	—	—	—
+	+	+	+	+	+	—	—	—	—	—	—	—	—	—	—	—
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...andicans Type.																
+	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

we do not know the age of the cells which serve as the basis of laboratory study; we do not know whether water has been the habitat of the cells for some time previous; or whether they have been lodged upon dry soil where their survival has been seriously threatened; and we do not know whether they have recently found favorable conditions for growth, and if so whether they have had to share them with members of other species, thus giving rise to possible modifications of characters through symbiosis. This train of thought could be carried much further, as it doubtless has been by many bacteriologists. But it is clearly a phase in species work which requires more careful attention than it has previously received. By a laboratory procedure, which we call preliminary cultivation, and which is briefly described just beyond in a topic following some comments on laboratory methods, it is believed that material aid may be derived towards the correction of the disturbing factor.

2. The composition and methods of preparation of culture media, as specified by the report of the Bacteriological Committee, are in a state which seems to be as satisfactory as available evidence allows, and there is no question of the advantages which should follow the universal adoption of this important and fundamental step in species work.

3. Concerning the temperature of development in species work, it has been our experience that, for the purpose of securing data for classification of water bacteria, those data obtained from the several tests with 20 degrees C. as the temperature of development, with a record of ability or inability to grow at 37 degrees C., are sufficient. This saves considerable labor in duplicating most of the work at 37 degrees, and in our opinion tends to make the data more specific in that it eliminates errors which may arise in some of the tests from failure to differentiate between the absence of growth at 37 degrees and positive growths with negative results.

4. The period of development is a point in methods for species differentiation which requires a more definite standard practice than now exists. In order to include the great majority of information derived from the tests, and at the same time not to make the methods unduly cumbersome and liable to inaccuracies from contamination and abnormal modifications, we would suggest ten days as a standard period of development at 20 degrees C. to be used for the classification of water bacteria. Further, this suggestion involves the omission without exception of all modifications in data which might appear beyond this period, except as supplementary notes, and in connection with special studies.

II.

PRELIMINARY CULTIVATION.

With the view to eliminating in a measure if possible the effect of debilitation of the bacterial cells, which may exist prior to their isolation from water as alluded to above, it has been our custom in species work to subject the pure cultures at the outset to a prelimnary cultivation. That is to say, before undertaking the various tests, the bacteria were cultivated in a special manner with the object of rejuvenating them in the event of possible debilitation. Several procedures were tried, but the one which appeared to be most satisfactory is as follows:

After obtaining the bacterium in pure culture it is transplanted to nutrient broth; from the latter, after three days development at 20 degrees C to gelatine plates; thence after the same period and temperature of cultivation back to an agar tube; and finally after the agar tube culture has developed for three days at 20 degrees C. the conventional media are seeded.

As a result of this preliminary cultivation it was found that more consistent results could be obtained, and that discordant results less frequently were met with from the same test of the same organism. It seemed to be a factor worthy of serious consideration, and one which it is very likely might in some cases at least be modified so as to be more applicable under different conditions. How much aid it would offer in the hands of other workers, studying bacteria from different sources, cannot be said; but it enhanced the reliability of the Cincinnati data to a degree that warrants, in our opinion, a thorough trial in different laboratories as a promising step in the right direction.

III.

PERCENTAGE CONSTANCY OF TESTS.

It has been our custom, so far as time permitted, to make a special study of the uniformity with which the same result could be obtained in cases where the same organism was subjected to the same test under the same laboratory conditions. For convenience we have called this the determination of the percentage constancy of a test.

In this way we were enabled to learn definitely the value of preliminary cultivation. Not infrequently from a series of tests the percentage constancy would be from 85 to 95 without this procedure and normally it was 100 with it. By the use of such means the real differential value of various tests can be definitely known.

To pronounce finally the percentage constancy of all the diagnostic tests now in use is something beyond the scope of the workers from one laboratory, largely because the men in different laboratories do

not appear to make all tests with equal skill. It would be our view that the percentage constancy of all leading tests should be worked out separately at each laboratory, and that at a subsequent meeting of this committee steps towards the final acceptance or rejection of tests should be taken, based on the joint evidence.

As a result of our experience at Cincinnati the tests noted on the accompanying chart were found in our hands to yield a percentage constancy of 100 when employed subsequent to preliminary cultivation.

IV.

WITH REGARD TO THE NECESSITY OF DISCONTINUING INDEFINITE METHODS OF DESCRIBING AND RECORDING THE RESULTS OF DIFFERENTIAL TESTS, AND THE ADVANTAGES OF A SIMPLE PROCEDURE TO OVERCOME PRESENT DIFFICULTIES.

It has been the experience of the writers that, when comparisons were made between descriptions of diagnostic tests in current work with those of their own work at an earlier date, uncertainties would arise in equating the results as described. When comparisons were made with descriptions of other workers, the situation would frequently be still more perplexing.

To a large degree, in our opinion, these complications are due to differences in the point of view held by different workers, and even by the same worker on different occasions; and which are unconsciously magnified by the personal equation which affects the style of writing verbal descriptions.

If called upon, in a criticism of the present literature upon species work, to name the chief factors leading to the present difficulties of identifying a species from published descriptions, we would surely be inclined to include among them the indefiniteness of verbal descriptions now extant. To our thought the influence of this condition of affairs has been great, due to inability to recognize the main points of similarity owing to the disguise resulting from undue weight being given to trivial points.

This topic has been discussed by several writers; but, so far as our knowledge goes, it was most exhaustively reviewed by Dr. Wyatt Johnston, who recommended that more attention should be paid to definite information which could be expressed positively or negatively. To some it doubtless appears that such a procedure would lead to a very crude classification. This would be true to a degree. But it is equally true that a substantial and permanent ground work for species differentiation is required, before the main points can make their permanent value felt.

During our work at Cincinnati we made use of the simple procedure of recording by plus or minus signs the results of 26 tests which gave satisfactory data in our hands. Based on this experience, the position was reached that the adoption of this simple procedure should be extended so that all published results could be adjusted to it as a foundation, and upon it could be built the additions and improvements which the future will bring to this branch of science.

To illustrate this procedure we will briefly describe the chart which accompanies this paper, and which represents concisely the results of species differentiation of the more promient bacteria in the Ohio River water at Cincinnati.

V.

DESCRIPTION OF CHART FOR CLASSIFICATION OF WATER BACTERIA.

It is hardly necessary to recall to your attention the chief and obvious feature of this chart, that is, that the data represent tests which gave to us clearly defined results capable of expression by the plus or minus sign, when made in accordance with the views briefly outlined in this paper. We would not presume to offer the opinion that exactly these tests would represent the results coming from longer experience and the efforts of more bacteriologists. In fact we consider it certain that modifications in details will be made in the future. But it is the general procedure illustrated by this chart which we wish to commend to your attention.

The second feature of this chart is the arrangement of species of bacteria into groups. This is, of course, arbitrary, and many objections can be raised to it. Nevertheless it is thought that on the grounds of convenience the advantages outweigh the disadvantages of its use in the classification of water bacteria.

The tests used in separating these water bacteria into thirteen prominent groups were as follows:

Fluorescence and chromogenesis.

Liquefaction of gelatine.

Well marked characteristics of typical colonies on gelatine plates.

Fermentation of carbohydrate.

On the basis of these provisional group tests, thirteen groups were obtained which may be described as follows:

Group I. All fluorescent forms.

Group II. All red chromogenic forms.

Group III. All orange chromogenic forms.

Group IV. All yellow chromogenic forms.

Group V. All violet chromogenic forms.

Group VI. All non-fluorescent, non-chromogenic, gelatine-liquefying bacteria, forming proteus-like colonies on gelatine.

Group VII. All non-fluorescent, non-chromogenic, gelatine-liquefying bacteria, forming subtilis-like colonies on gelatine.

Group VIII. All non-fluorescent, non-chromogenic, non-proteus and non-subtilis-like bacteria, which liquefy gelatine and ferment carbohydrate with the production of gas.

Group IX. All bacteria conforming to the specified characteristics of Group VIII, except that fermentation of carbohydrate takes place without the formation of gas.

Group X. All bacteria conforming to the specified characteristics of Group VIII, except that no fermentation of carbohydrate occurs.

Group XI. All non-fluorescent, non-chomogenic, non-gelatine liquefying bacteria, which ferment carbohydrates with the production of gas.

Group XII. All bacteria conforming to the specified characteristics of Group XI, except that fermentation of carbohydrate takes place without the production of gas.

Group XIII. All bacteria conforming to the specified characteristics of Group XI, except that no fermentation of carbohydrate occurs.

It will doubtless occur to many that there may be a likelihood of the characteristics of one group becoming fused into the one closest allied, especially in the case of two of the four chromogenic groups. The writers experienced no difficulty in this direction from the non-chromogenic forms; and the difficulties arising from occasional confusion of the chromogenic groups were overcome as follows:

We learned at the outset that those cultures giving colors which were neither distinctly yellow nor orange must be placed among the non-chromogenic forms. We also learned that it was desirable to employ agar tubes of three reactions in the determination of fluorescence and chromogenesis, namely,—1.5, 0, and 1.5 per cent. referred to the phenolphtalein neutral point.

No difficulty was experienced in successfully handling the red and violet chromogens.

The colors embraced in the four chromogenic groups may be briefly described as follows:

Red. That color produced by the growth of bacillus prodigiosus on agar.

Yellow. That color produced by the growth of Sarcina lutea on agar, with the dividing line between this and the orange group at the yellow-ochre hue produced by the growth of bacillus ocraceus on agar.

Orange. This color begins just below the yellow-ochre stage. The true orange is the same as that produced by bacillus aurantiacus on agar.

Violet. The same as that color produced by the growth of bacillus violaceus on agar.

In the use of this chart it may be stated that it was our custom to record the characteristics of each new species, as it was found, on a record chart; and, as each new set of organisms was studied, their characteristics were recorded on a similar working chart of the same size. A comparison was facilitated by folding the chart on which the current records were kept so that the characteristics of the form under study appeared on the top line. A glance of the eye was sufficient to show whether or not the newly isolated form was identical with any of those previously studied; and if not, wherein it differed from other members of the same group.

In this way we were enabled to record concisely for prompt comparison the leading characteristics of forty-two species of bacteria found in the Ohio River water at Cincinnati.

THE OBSERVATION OF ODOR AS AN ESSENTIAL PART OF WATER ANALYSIS.

By GEORGE C. WHIPPLE, Assoc. M. Am. Soc. C. E.,

Biologist and Director of Mt. Prospect Laboratory, Brooklyn, N. Y.

The odor of drinking-water is one of its most important characteristics. There is hardly another quality of our public water supplies that has been the cause of so much complaint on the part of the consumer. People will submit to the use of water that is turbid or highly colored; and—alas! for their ignorance—they will submit to the use of water that is polluted; but if they are compelled to drink water that tastes bad and smells bad they will rise in rebellion. This arises, no doubt, from the deeply-rooted, almost instinctive idea that whatever smells bad and tastes bad must be bad. It is not the purpose of the present paper to prove that this instinct plays us false in the case of water, but rather to show how the proper use of the sense of smell may help us to decide whether a water is simply unpleasant to drink or whether it is unwholesome.

The sense of smell is distinct from the sense of taste, but the two are closely related. There are some substances, like salt, that have a taste but no odor, and there are other substances, like vanilla, that have an odor but no taste. It is believed that the sense of smell is the more comprehensive and that many so-called tastes are really odors, the gas or vapor given off by the substance reaching the olfactory nerves not only through the nostrils but through the posterior nares. Thus, an odor tasted is often stronger than an odor smelled.

Chemically pure water is free from both taste and odor. Water containing certain substances in solution may have a decided taste but no odor. This is the case with many mineral waters. Such tastes, however, are not common and seldom affect large bodies of water. Most of the bad tastes observed in domestic water supplies are due not to inorganic but to organic substances either in solution or in suspension. These substances almost invariably produce odors as well as tastes. The subject may be pursued therefore from the standpoint of odor, though in many cases the best way to obtain the odor of the water is to taste it.

The observation and description of the odor of a sample of water is not such an easy matter as one might at first suppose. With most

persons the sense of smell is imperfectly developed, and there is an almost utter lack of any standard by which to describe an odor as to its quality or its intensity. Fortunately, however, the sense may be cultivated, and I have no doubt that in time some satisfactory system of expression will be eveloved.

The odor of a sample of water should be observed, if possible, at the time of collection, and again after the sample has stood long enough to come to room temperature. The observation is best made by partially filling a 2-litre or a 4-litre bottle with the sample, shaking vigorously, removing the stopper and quickly applying the nose. This gives what is called the "cold odor." The "hot odor" may be obtained by putting about 200 cc. of the sample in a tall beaker covered with a watch-glass, and heating to a point just short of boiling. After this has cooled sufficiently the beaker should be thoroughly shaken, the watch-glass slipped aside and the nose applied. The hot odor is usually stronger and more characteristic than the cold odor.

Other methods have been suggested for obtaining the odor of water, but after many experiments with various bottles, flasks, atomizers, etc., the writer has taken recourse to the simple method described above, which has been long in use in the laboratory of the Massachusetts State Board of Health. If the sample is examined microscopically according to the Sedgwick-Rafter method, it is advisable to corroborate the odor taken as above by observing the taste and odor of the concentrated microscopic organisms.

In laboratories where many samples are examined, it will be found convenient to heat a large number of samples at one time on an iron plate. The plate used by the writer is 30 inches long, 18 inches wide, ⅜ inches thick, and will hold twenty-four beakers. It stands 7 inches above the laboratory table, and is heated by two solid-flame gas burners. The beakers are 3 inches in diameter and about 5 inches high, without lip. The watch-glasses are 3½ inches in diameter. The watch-glasses fit the flanges of the beakers closely to prevent the escape of the gases driven off. The beakers are lifted from the plate before boiling has fairly begun, and set aside to cool.

It is difficult to describe the odor of water in terms that readily convey a definite meaning. The usual method is to state its character by comparing it with some well-known odor and to modify this by some adjective showing its intensity. For the quality of the odor this is about all that can be done, but for the intensity it is possible to devise a graded scale. The Massachusetts State Board of Health uses the terms *very faint, faint, distinct, decided, very strong,* and many analysts have adopted this scale. For the sake of brevity in recording and printing the results it seems desirable to adopt a numerical scale to express the inten-

sity of the odor. This may be made to correspond with the scale of terms just mentioned, and may be defined approximately as follows:

NUMERICAL SCALE.	MASSACHUSETTS STATE BOARD OF HEALTH.	APPROXIMATE DEFINITION
0	*None.*	No odor perceptible.
1	*Very Faint.*	An odor that would not be ordinarily detected by the average consumer, but that could be detected in the laboratory.
2	*Faint.*	An odor that the consumer might detect if his attention were called to it, but that would not otherwise attract notice.
3	*Distinct.*	An odor that would be readily detected and that might cause the water to be looked upon with disfavor.
4	*Decided.*	An odor that would force itself upon the attention and that might make the water unpalatable.
5	*Very Strong.*	An odor of such intensity that the water would be absolutely unfit for drinking. (A term to be used only in extreme cases.)

The descriptive adjectives may be abbreviated or expressed by letter and used in connection with the numerical scale, as follows:

v—*vegetable.*
p—*peaty.*
s—*sweetish.*
e—*earthy.*
g—*grassy.*
a—*aromatic.*
f—*fishy.*
m—*moldy.*
d—*disagreeable,*
etc.

Thus "2 *v*" would mean that the water had a vegetable odor that might be detected by the consumer; "3 *g*," that the water had a grassy odor sure to be observed; "4 *f*," that the odor was fishy and strong enough to cause people to object to drinking the water; and "3 *v* + 2 *m*," or "$\frac{3\ v}{2\ m}\}$" would mean that the water had a distinct vegetable odor and, in addition, a faint moldy odor.

The writer believes that the use of such a system of abbreviations would enable the odor to be recorded as an integral part of the analysis of water, whereas at the present time many valuable data are omitted from published records simply because of the space required for the long descriptive terms now used.

Long continued observations have shown that the odors observed in drinking waters may be grouped into three classes, as follows: 1. Odors caused by organic matter other than living organisms. 2. Odors caused by living organisms. 3. Odors caused by the decomposition of organic matter.

The odors caused by organic matter other than living organisms may be described by the general term *vegetable*. They vary in character in different waters and in different seasons, and have been described as *straw-like, swampy, peaty, marshy, sweetish,* etc. It seems preferable to use the term *vegetable* to cover all these odors, because they are due chiefly to vegetable matter in solution. Brown-colored waters almost invariably have a *sweetish-vegetable* odor, and the intensity of the odor varies almost directly with the depth of the color. Both color and odor are due to the presence of glucosides, of which tannin is an example, extracted from leaves, grasses, mosses, etc. In addition to the odor these substances have a slightly astringent taste. Colorless waters that contain organic matter may have *vegetable* odors, but they are usually less sweetish and more *straw-like*, or *peaty*. Akin to the *vegetable* odors are the *earthy* odors caused by finely divided particles of organic matter, clay, etc. The two odors are often associated together in the same sample.

The odors that are due to living organisms are important because of their common occurrence, because of their offensive nature, and because they affect large bodies of water. It is only since the development of the microscopy of drinking water that these odors have been well understood, and even now there is much to be learned about the chemical nature of the odoriferous substances and their relation to the life of the organisms. At one time it was supposed that it was only by decay that the organisms became offensive, but it is now well recognized that many living organisms have distinctive odors during growth and that in most cases the odor is produced by substances analogous to the essential oils. If the organisms are examined with a microscope

of sufficient power the oil-globules may be observed. These natural odors are intensified by whatever agency serves to break up the organisms or to liberate the oil-globules, and hence they are sometimes referred to as odors of disintegration.

It is possible that some of the odors of this class may be due to aquatic life that develops upon the shores of ponds and reservoirs, but in by far the greater number of instances the odors may be traced directly to microscopic organisms in the water itself.

The odors produced by the most common microscopic organisms are now well known. They may be grouped around the three general terms, *aromatic*, *grassy*, and *fishy*. The following is a list of the most important ones:

GROUP.	ORGANISM.	NATURAL ODOR
Aromatic Odor.	*Diatomaceal.*	
	Asterionella.	Aromatic, geranium, fishy.
	Cyclotella.	Faintly aromatic.
	Diatoma.	" "
	Meridion.	Aromatic.
	Tabellaria.	"
	Protozoa.	
	Cryptomonas.	Candied violets.
	Mallomonas.	Aromatic, violets, fishy.
Grassy Odor.	*Cyanophyceal.*	
	Anabaena.	Grassy and moldy, green corn, nasturtium, etc.
	Rivularia.	Grassy and moldy.
	Clathrocystes.	Sweet, grassy.
	Coelosphaerium.	" "
	Aphanizomenon.	Grassy.
Fishy Odor.	*Chlorophyceal.*	
	Volvox.	Fishy.
	Eudorina.	Faintly fishy.
	Pandorina.	" "
	Dictyosphaerium.	" "
	Protozoa.	
	Uroglena.	Fishy and oily.
	Synura.	Ripe, cucumbers, fishy.
	Dinobryon.	Fishy, like rock weed.
	Bursaria.	Fishy, Irish moss, salt-marsh.
	Peridinium.	Fishy, like clam shells.
	Glenodinium.	Fishy.
	Chlamydomonas.	Fishy and disagreeable.

The aromatic odors are due chiefly to the Diatomaceæ. The most important, because the strongest and most common, is that of Asterionella. This odor is very characteristic at all times, but as its intensity

increases its quality becomes altered, changing from *aromatic* to *geranium* and then to *fishy*. This change of quality of the odors with increasing numbers of the microscopic organisms is a common phenomenon.

The *grassy* odors are produced by the Cyanophyceæ and the most important is that due to Anabæna, an organism that usually develops in the late summer.

The *fishy* odors are the most disagreeable of any observed in drinking water. That produced by Uroglena is perhaps the worst and the most common. It is intensely *fishy*. It is a difficult odor to trace because of the fragile nature of the organism. Samples of water will hold the odor long after the organisms themselves have disappeared. The odor of Synura is next in importance. It is usually *fishy*, but at times resembles the odor of ripe *cucumbers*, and has associated with it a strong, bitter and spicy taste.

Besides the organisms enumerated above there are several other common forms, such as Synedra and Melosira, that, when present in large numbers, give rise to an indistinct and not very characteristic vegetable odor.

So far as known the presence of vegetable odors and the various odors due to microscopic organisms are practically without sanitary significance because the substances which produce them and the organisms with which they are associated are not known to be injurious to health. Not so, however, with the odors of decomposition. These odors are a valuable index to the sanitary quality of the water. They are described, somewhat imperfectly, by such terms as *moldy*, *musty*, *unpleasant*, *disagreeable*, *offensive*, etc. *Unpleasant* odors may be produced by the decay of vegetable matter, and as the decay goes on they may become *disagreeable*. Disagreeable and offensive odors, however, are more often traced to the decomposition of animal matter. The terms *moldy* and *musty* are somewhat more specific than the terms *unpleasant* and *disagreeable*, but they are quite as difficult to define. The *moldy* odor suggests a damp cellar, or a decaying tree-trunk. The bacteriologist will recognize the odor as that given off by certain bacteria growing on nutrient gelatin. For the sake of simplicity it seems desirable to dispense with some of these terms and use the adjectives *moldy*, *musty*, and *disagreeable* in connection with the numerical scale of intensity.

The odors of decomposition are often observed in connection with the natural odors of the organisms. Anabæna, for example, decays readily, and usually gives rise to an odor that is *moldy* as well as *grassy*.

In the absence of microscopic organisms, however, the *moldy* and *disagreeable* odors are of great value to the analyst, furnishing an index

of pollution equal to that of any other single test, and greatly strengthening the results obtained by the chemical and bacteriological examinations. This is strikingly shown by the following table containing certain data obtained from the analysis of weekly samples from a series of ponds, existing under similar geographical and climatic conditions, and differing chiefly by the amount of pollution they receive:

TABLE SHOWING THE RELATION BETWEEN THE ODORS OF DECOMPOSITION AND THE SANITARY QUALITY OF WATERS. (BASED ON THE RESULT OF WEEKLY ANALYSES FOR ONE YEAR.)

Locality.	Per Cent. of Samples That Gave Odors of Decomposition.	Average Number of Bacteria Per C.C.	Per Cent. of Samples That Gave Positive Coli Tests.	Nitrogen as Free Ammonia Parts per Million.	Nitrogen as Nitrites Parts Per Million.
1	100	6030	63	.106	.015
2	92	1190	43	.041	.009
3	50	1330	33	.037	.005
4	48	780	29	.011	.008
5	37	630	29	.020	.006
6	22	610	20	.021	.003
7	20	360	8	.019	.006
8	17	390	8	.008	.001
9	12	630	6	.010	.004
10	10	220	6	.030	.002
11	10	440	13	.021	.003
12	10	430	6	.022	.002
13	8	480	3	.008	.001
14	8	430	0	.007	.003
15	6	360	6	.010	.004
16	6	220	0	.005	.001
17	4	210	0	.007	.000
18	2	290	0	.010	.000
19	2	270	0	.005	.001
20	0	370	0	.006	.000

It will be seen that there is a marked coincidence between the frequency of occurrence of odors of decomposition and the frequency of occurrence of Bacillus coli communis in the samples,—and the same holds true for the number of bacteria per cc., the free ammonia and the nitrites. Furthermore, these figures agree with the known facts regarding the relative pollution of the various ponds. Nos. 1, 2 and 3 are badly polluted, and are not used for public water supply, while Nos. 16, 17, 18, 19 and 20 are from almost uninhabited watersheds.

From the above facts it seems to be conclusive that with proper discrimination between the various odors of drinking waters, this simple test is of great value to the sanitarian and ought to be considered as an essential part of every water analysis.

SYNOPSIS OF A PAPER UPON "THE ACTION OF WATER UPON LEAD, TIN AND ZINC, WITH ESPECIAL REFERENCE TO THE USE OF LEAD PIPES WITH MASSACHUSETTS WATER SUPPLIES."

By H. W. CLARK,

Chemist of Massachusetts State Board of Health.

The investigation described covers a period of about two years, and about one thousand samples of water from various public water supplies of the State were analyzed for the presence of lead. Answers to inquiries to water department officials of 136 of the cities and towns of the State which had public water supplies showed that 71 of the towns used lead or lead-lined service pipes; seven of the towns reporting that all the service pipes were lead or lead-lined, while in the other towns various other pipes were used more or less. From thirty of the municipalities where lead pipes were in use, one or more series of samples of water were taken for the exact determination of lead, and it is these supplies that were largely studied to determine what waters of the State attack lead pipes and what waters do not, and the reasons therefor. Various tables are given, showing the amount of lead found in samples of water from various places; these tables showing the amount found when the water was in ordinary daytime use and also the amount found when the water stood over night in the service and house pipes. As all of these water supplies had been analyzed by the State Board several times a year for a number of years, the figures obtained by these sanitary analyses could be directly compared with the amount of lead, to show the relation that might exist between the various mineral and organic substances found in the water and the lead taken from the pipes by these various waters. Many tables making these comparisons are given in the paper; these tables indicating that surface waters having the greatest amount of solids and chlorine and the greatest degree of hardness take the least lead from the pipes, while with the ground waters those with the greatest solids and hardness take generally the least amount of lead; these comparisons, however, not showing the active agent in attacking lead.

Very many studies were also made in which mineral and organic substances were added to distilled water in which lead pipe had been placed, to show the increased or decreased action on the lead caused by the presence of these substances in the water. These experiments are described in full and the results given in the paper. Summarizing the

experiments, it was shown that the action upon lead, taking place in distilled water containing oxygen, was more violent than the action taking place in any natural water which was examined or experimented with; also that the action of the distilled water upon lead was increased by the addition of small amounts of ammonia or potassium nitrate to the water; that it was decreased very greatly by the addition of sodium chloride, calcium carbonate, sodium silicate, or by anything which increased the hardness or total solids of the water; also it was generally decreased by the presence of organic matter. It was noted that, when oxygen and carbonic acid were removed from distilled water and the bottles sealed to prevent access of air, the action of the water was reduced almost to a minimum. It was also demonstrated that the action of ammonia and potassium nitrate was not direct, but because these bodies are carriers of oxygen; that water in which they were present, but from which the air was excluded, had little effect upon lead; and that the addition of organic matter in comparatively small amounts to distilled water in which these gases were present, nullified their action upon lead.

Various experiments were made and are given in the paper, emphasizing the fact that oxygen and carbonic acid are the principal factors present in water which attacks lead. Determinations of the free oxygen and free carbonic acid, in the water supplies of the State which most actively attack lead, were made and it was found that there was a very direct relation between the amount of lead taken from lead pipes and the amount of carbonic acid in the water supply, especially with the ground waters, and a table illustrates this fact. With the surface waters it was found that, in the clear, comparatively colorless and soft surface waters, free oxygen was generally the important factor in attacking lead.

Investigations made showed that practically all the cases of lead poisoning in the State, so far located, were in towns and cities having ground water supplies. In these places a larger proportion of the lead was in solution in the water than in the samples from surface water supplies where oxygen present in the water was the prime factor in attacking the lead pipes.

Experimental pipes of iron, lead, galvanized iron and block tin were placed in several of the towns of the State where the waters were known to attack lead violently; these experiments showing that, besides the lead, zinc was attacked by the waters, but that these waters affected tin to a very slight degree.

In the course of the work an improved method of determining the amount of lead in samples of water was worked out. It is a colorimetric method and is fully described in the paper and is considered to be quite successful in determining accurately the small amount of lead

usually found in one gallon of water from the various municipalities where lead or lead-lined service pipes are used.

DISCUSSION.

Dr. Johnston, Montreal.—I was very much interested in the paper of Professor Russell relative to the gas-producing bacteria, because I think that the question of isolating typhoid and colon and allied forms is one of the most important problems that the working sanitary bacteriologists have to deal with. We find that more is asked of us than we are ready to give. We must be very cautious in the way of giving opinion when we are asked as to whether the water from a certain source is polluted or not. While we can easily say whether the conditions are such that the water is polluted, it is harder to say just what that pollution is.

Dr. Russell, Madison.—I will say in this connection they were all made on glucose sugar, and the larger part of our work is with that, although we use "lactose" also; and the gas formulæ agree fairly well as between glucose and lactose.

Dr. Johnston.—I think that if some form of procedure could be formulated with a view to qualitative analysis of water supplies of suspicious samples of water to decide fairly promptly whether they were locally contaminated or not, it would be a matter of considerable importance, and the general secretary was saying that executive men would be very glad if the laboratory section could get some sort of working data as to the extent to which one might reply on observations as to the actual detection of the typhoid bacillus in water.

Dr. Ravenel, Philadelphia.—There is one point in regard to the examination of water supplies which I would like to call to the attention of the meeting, and would ask the members of this committee to look into more fully, and that is what role do fresh water fish play as a source of colon bacilli. They may be a source of typhoid fever, or may be contaminated by the water supply. In conversation here to-day with Professor Russell, he stated his fish were fed on fecal matter, which to a certain extent, I think, cast doubt on the question of fish in general. I, myself, have examined twenty specimens, perhaps, without ever having found a colon bacillus in a single fish. Professor Whipple's experience, I think, agrees very closely with that.

Dr. Gehrmann, Chicago.—I agree thoroughly with Dr. Johnston in regard to reporting results in the number of colonies found in samples sent in from a source not exactly described, and make it a rule not to

report any colony count on such samples at all. As to my own special experience in the isolation of the bacillus coli, I can say that for a considerable length of time I have used a carbolic acid bouillon for fermentation, having to the liter fifteen grams of peptone, two and a half grams of beef extract and 1 per cent. C. P. glucose, and adding .15 per cent. carbolic acid. The ordinary fermentation tube is used and the cultures are incubated at 40 per cent. degrees over night. The amount of gas that forms I find to be of very little value when carbolic acid is used. Different cultures that we have studied give different amounts of gas varying to a considerable extent, not being uniform probably on account of the acid which trains the growth. The next step is to make a microscopic examination in a hanging drop of the water in the tube, and to be certain to eliminate yeasts and to examine for spore bearing forms, and note if the bacilli are motile. The straight platinum rod is dipped to a greater or less depth into the bouillon and is carried into a slanted agar tube of the ordinary composition, and the water in the bottom of the tube is inoculated. A little plate culture is then made by flowing the water over the surface and keeping in an upright position. Sometimes where the growth is very abundant this transfer is made to a second tube.

The tubes are then placed in an incubator for twenty-four hours. We look for characteristic colonies—pick out as many colonies as seem to be characteristic, and sometimes, as we have found in a good many cases, practically a pure culture of coli results. These colonies are transferred to agar and the culture is then put through the usual methods for identifying the bacillus, and upon the identification.

H. W. Clark.—The importance of determining the presence of B. coli in filtered water is well illustrated by a Lawrence experience. Following some repairs made on the Lawrence City Filter, some interesting observations on the result of the presence of B. coli in filtered water were made. About a year ago, in order to renew the underdrains and increase the flow of water through the filter, sand was removed from several sections of the filter, washed and replaced, this work being done at several different times during the months of October, November and December. After the work in October and November, the bacteria in the effluent of the filter were high for a day or two, but no serious results, as far as sickness in the city was concerned, seemed to follow. At the time of the December work, there was some very cold weather, and the sand replaced was left in a frozen, lumpy condition. This allowed

the water to pass through this section of the filter very rapidly and the number of bacteria in the effluent remained apparently high for a period of two weeks, and coli was found in the effluent frequently for a much longer period. Following this we had more typhoid fever in Lawrence than had occurred since the construction of the filter. It is noticeable that cases of typhoid fever continued to be reported long after the daily number of bacteria in the effluent had become normal, but during this period B. coli was found frequently in the effluent. When we ceased to find B. coli in 1 c.c. of the filtered water, the epidemic ended.

In regard to the Hesse media mentioned in Dr. Jordan's paper, we have been investigating it at Lawrence and, using it instead of peptone, have obtained results which are remarkable, especially when used in connection with the determination of the bacteria in ground water. Ground waters which show generally only two or three bacteria per cubic centimeter when determined with the usual media, have shown 200 or 300 per cubic centimeter when the Hesse media has been used.

Dr. Bryce, Toronto.—I have been very much interested in the methods for analysis of the drinking water in determining the real character as a conveyor of disease. With us, we have for several years endeavored in obtaining from a certain area a number of samples for examination; say, from a town where there is no public water supply, we would endeavor to obtain samples of the town water, if there is one, and then from a local well of what one might say was water of undoubted purity, that is, a well so situated that there could be no possibility of its pollution locally. In our district, certainly in our province, the superficial sands and gravels are such that our water is very different in all parts of the country. Having established what we would call a normal water for that particular town or area in question, we endeavor to compare with this the analysis of the various samples in order to determine, if possible, their relative purity. The samples that Dr. Mackenzie usually sends are reported to the office and returned to their locality containing two facts. The first one is, the number of bacteria of all sorts, with the ordinary adopted standard of cultivation. The second is whether the colon bacillus is present. One point I would call attention to is the chemical constituent of chlorine. If we take a dozen wells in a town the chlorine is about fifteen parts to the million. If you find it running up to thirty, with bacteria in excess you can pretty surely tell that that particular water is dangerous water.

Dr. Hill.—The point I wish to make, or rather which has been made before, is an old one, that it does not matter what medium is used, whether it gives the highest count or not; the main thing for all water

workers is to get uniform results, and to adopt a standard medium, which will allow comparison of one work with another.

Mr. Whipple, Brooklyn.—I wish to refer to the effect of moisture. We have invariably found that in a moist atmosphere the count was much larger than it was when dry; and that led to a series of experiments by which we made several cultures first in the moist chamber; second, in the ordinary incubator. These observations show a marked increase in the numbers of colonies when the plates are cultivated in a moist chamber.

Dr. Welch.—I would like to ask Dr. Russell whether the bacteria—gas-producing formula 1-2—would readily be confounded with colon bacilli were it not for the determination of the formula?

Dr. Horton.—I would like to ask if the gas formula seemed to change under cultivation; that is, whether the initial gas formula would change after continuous cultivation?

Dr. Russell.—Relative to the question asked by Dr. Welch will say that the organism—1-2 formula—has been subjected to other tests, and a very great degree of difference in regard to them is noticeable in not a few instances; perhaps I might say in the 1-2 class, we have at present something like thirty to forty bacteria under observation; many of them have colon affinities. With reference to the variation in the gas formula between initial cultures and those which are kept under observation for some time, will say that there is some variation. I have not collected data on that to any large extent.

Dr. Swarts, Providence.—I think that a committee should be appointed to formulate some standard for analysis of water. I, therefore, move that such a committee be appointed at this meeting, who shall present at the next meeting a standard formula for the analysis of water which shall be the recommended method of analysis of this Association.

Dr. Welch, Chairman.—I announce the following names for that committee: Mr. George W. Fuller, Professor H. L. Russell, Professor E. O. Jordan, Dr. Adolph Gehrmann, Dr. Wyatt Johnston, Mr. C. W. Whipple, and Mr. H. W. Clark.

THE IODOMETRIC DETERMINATION OF SMALL QUANTITIES OF CARBON MONOXIDE.

By LEONARD P. KINNICUTT and GEORGE R. SANFORD.

In most American cities, carburetted water-gas by itself, or mixed with coal gas is used as the source of artificial light. This gas contains anywhere from fifteen to twenty-six per cent. of carbon monoxide and we thus have brought into our houses a gas whose dangerous properties are well known. It has been proved that air containing four-tenths of one per cent. of carbon monoxide causes death in warm blooded animals, and death may sometimes occur, according to Dr. Haldane, with as little as two-tenths of one per cent.,[1] and by experiments upon himself Dr. Haldane proved[2] that an exposure of several hours to as little as even seven hundredths of one per cent. not merely caused dizziness, but a headache lasting twelve hours, and there is reason to believe that the continuous breathing of air containing still smaller quantities may have an effect on human organism. The question therefore of detecting and determining very small amounts of carbon monoxide when mixed with large quantities of air is one of decided importance.

The methods of detecting and estimating very small amounts of carbon monoxide may be divided into two classes; first, those in which carbon monoxyhæmoglobin is formed; second, those in which it is oxidized to carbon dioxide. Those of the first class are of little value except for detection of the gas, and they may all be considered as modifications of Hoppe-Seyler's method, first published in 1864,[3] which is based on the fact that while both carbon monoxyhæmoglobin formed by the action of carbon monoxide on arterial blood, and oxyhæmoglobin, give two absorbtion bands in the spectrum oxyhæmoglobin is alone reduced to hæmoglobin by the action of such reducing agents as ferous sulphate or ammonium sulphide.

The method of determining carbon monoxide by oxidation to carbon dioxide has not, until the past few years, received much attention. This oxidation can be accomplished by the use of many oxidizing agents, but of all those which have been proposed iodine pentaoxide is, from our experience, the one that can best be used for the determination of small amounts of carbon monoxide.

1 Parlimentary Report on the Manufacture and Use of Water-Gas, 1899, page 71.
2 Journal Society of Chemical Industry, 1896, page 856.
3 Zeitscrift Anal. Chem., 1864, page 439.

Ditte,[1] in 1870, showed that at temperatures between 150-200 degrees iodine penta-oxide was decomposed by carbon monoxide, iodine and carbon dioxide being formed.

$$I_2O_5 + 5\,CO = I_2 + 5\,CO_2$$

This reaction was seemingly first used by C. de la Harpe and F. Reverdine[2] for the detection of the gas, and Nicloux[3] and Gautier[4] have made use of the reaction for its quantitative determination.

Nicloux determined the iodine set free, by the depth of color formed in a chloroform solution, and Gautier by the amount of carbon dioxide formed. We have not by either of these methods been able to obtain accurate determinations of small amounts of carbon monoxide, but have obtained most satisfactory results by determining the amount of iodine set free, with an N-1000 solution of thiosulphate of sodium.

The apparatus used was, with slight changes, that described by Nicloux. Twenty-five grams of iodine penta-oxide was placed in a small U tube, which was suspended in an oil bath and connected with a Wolff blood absorption tube containing one-half a gram iodide of potassium dissolved in five cubic centimeters of water. The tube containing the iodine penta-oxide was also connected with two U tubes, one containing sulphuric acid, the other small pieces of potassium hydrate, so as to remove from the air to be analyzed (before it came in contact with the iodine penta-oxide) all unsaturated hydro-carbons, sulphide of hydrogen, sulphur dioxide and similar reducing gases. In all the experiments the oil bath, in which the U tube containing the iodine penta-oxide was suspended, was heated to 150 degrees centigrade, as preliminary tests showed that the reaction was not a quantitative one at lower temperatures.

The iodine penta-oxide was made by the action of nitric acid on resublimed iodine, and after this substance had been purified by the usual methods, the last traces of free iodine were removed by passing air, freed from all reducing substances, through the iodine penta-oxide contained in a U tube, heated to 150 degrees centigrade.

In the experiments which were made to determine the accuracy of the above process, one liter of air was usually taken, but as is seen in the following table, amounts as small as 250 cubic centimeters were tried in several cases, and the rate at which the air was passed through the tubes was about one liter in two hours, the rate being controlled by forcing the air out of the bottle in which it was contained, by dry redistilled mercury, the flow of which was regulated by a glass stopcock.

1 Bull. Soc. Chem., 1870, Vol. 1, page 318.
2 Chem. Zeitung., 1888, page 1726.
3 Comptes Rendus, Vol. 126, page 746.
4 Comptes Rendus, Vol. 126, page 931.

The amount of carbon monoxide added to the air was accurately measured from a tube made of capillary glass tubing and accurately calibrated so that each division represented 0.005 cubic centimeters. The temperature and barometric pressure were carefully noted and all volumes were reduced to zero degree centigrade and 760 m. m. pressure, and the determination of the iodine set free was made in the Wolff blood absorption apparatus which contained the iodide of potassium solution.

With this apparatus used as described, we were able to determine as small an amount as 0.025 cubic centimeters of carbon monoxide, when contained in 1000 cubic centimeters of air, or 0.0025 per cent. by volume. The following table gives the results obtained:

ANALYTICAL RESULTS.

Volumes Taken in Cubic Centimeters.		Iodine Liberated in Millegrams.		
Air.	Carbon Monoxide.	Theoretical.	Found.	Difference.
1000	0.410	0.941	0.907	0.0340
1000	0.286	0.6575	0.6375	0.0200
1000	0.359	0.8178	0.7832	0.0346
1000	0.170	0.3859	0.4540	0.0681
1000	0.211	0.4809	0.4775	0.0034
1000	0.151	0.3442	0.3252	0.0190
1000	0.115	0.2639	0.2758	0.0019
1000	0.061	0.1391	0.1431	0.0040
1000	0.023	0.0535	0.0494	0.0041
1000	0.029	0.0672	0.0689	0.0017
1000	0.023	0.0535	0.0495	0.0040
500	0.131	0.2993	0.2976	0.0017
250	0.030	0.06862	0.07165	0.0030
250	0.026	0.05967	0.05855	0.0011

Volumes Taken in Cubic Centimeters.		Iodine Liberated in Millegrams.		
Air.	Carbon Monoxide.	Per Cent. of Carbon Monoxide Calculated.	Per Cent. of Carbon Monoxide Found.	Difference.
1000	0.410	0.0410	0.0395	0.0015—
1000	0.286	0.0286	0.0278	0.0008—
1000	0.359	0.0359	0.0341	0.0018—
1000	0.170	0.0170	0.0197	0.0027+
1000	0.211	0.0211	0.0208	0.0003+
1000	0.151	0.0151	0.0142	0.0009—
1000	0.115	0.0115	0.0119	0.0004+
1000	0.061	0.0061	0.0062	0.0001+
1000	0.023	0.0023	0.0021	0.0002—
1000	0.029	0.0029	0.0030	0.0001+
1000	0.023	0.0023	0.0022	0.0001—
500	0.131	0.0263	0.0260	0.0003—
250	0.030	0.0120	0.0124	0.0004+
250	0.026	0.0104	0.0100	0.0004—

These results having shown that, by the above method, accurate determinations could be made of very small amounts of carbon monoxide in pure air, it only remained to be proved that the accuracy of the process was not effected when the carbon monoxide was mixed with air containing illuminating gas and experiments were made to determine the action of hydrogen, marsh gas, unsaturated hydro-carbons, sulphide of hydrogen and sulphur dioxide on iodine penta-oxide.

Hydrogen and marsh gas, as was to be expected, had no effect on the oxide of iodine at 150 degrees centigrade, and the unsaturated hydrocarbons, sulphide of hydrogen and sulphur dioxide, in much larger amounts than are contained in illuminating gas, or formed by its combustion, were perfectly absorbed when passed in the way described through U tubes containing sulphuric acid and potassium hydrate.

These facts having been determined, mixtures of illuminating gas and air were made, and the amount of carbon monoxide determined.

Two experiments gave the following results:

The gas used contained 18.6 and 19 per cent. of carbon monoxide, respectively. Of the first, 0.104 cc. was added to one liter of air, and the air was found to contain 0.019 cc. of carbon monoxide, the calculated amount being 0.0191. In the second case, 0.146 cc. of the gas was taken, and the air was found to contain 0.028 cc. of carbon monoxide in place of 0.0279 cc.

The results that have been obtained show that the presence and amount of carbon monoxide in the air of a room can be determined when the air contains above 0.0025 per cent. by volume, or two and one-half volumes in one hundred thousand volumes of air, and if the presence of this gas is due to leakages of illuminating gas and the per cent. of carbon monoxide in the gas is known, the amount of illuminating gas contained in the air of the room can be approximately calculated. We hope in the near future to be able to describe a form of apparatus so simple in character, that the detection, if not the estimation, of as small an amount as 0.01 per cent. of carbon monoxide in the air of a room, can be made by any board of health inspector.

Worcester Polytechnic Institute, October, 1899.

DISCUSSION.

PROFESSOR ROBINSON, Brunswick.—It is well known that those inspectors engaged in public health work have been unable thus far to detect the presence of this gas in the air of rooms; and if they are able to detect it by the method of Dr. Kinnicutt a great step has been taken in advance.

DR. WELCH.—There is great danger from gas leakage from a stove and from gas. It is no doubt injurious to the health of occupants of rooms, and cannot be readily detected.

Mrs. E. H. Richards, Boston.—In 1883 and '84 a great deal of work was done in our laboratory on the determination of small quantities of carbon monoxide, using a modification of the palladium method. I have had occasion to test for this gas quantitatively at various times since both in legal cases and in the air of school-rooms and dwelling houses. Where water-gas is used an exact and a convenient method, such as this promises to be, is very desirable.

THE MAKING OF AGAR-AGAR.

By MAZYCK P. RAVENEL, M. D., University of Pennsylvania,

Bacteriologist to the State Live Stock Sanitary Board of Pennsylvania; Instructor in Bacteriology, Veterinary Department.

The making of agar-agar is usually regarded as an exceedingly tedious and difficult matter, and a perusal of the methods advised in even the most recent text-books must bring forth an involuntary groan from the hapless individual who is compelled to follow them. Even in books published within the last six months, we are told to boil the agar for two to three hours, to filter in a steam sterilizer, to use special filter paper made for the purpose; but in spite of all these things we are warned that filtration is very slow,—which is true if the directions are followed,—and that a liter will take from two to three hours to pass through the filter. Some authors advise sedimentation and make use of agar without filtration. As an actual fact agar is one of the easiest of our culture media to make, and the filtration of it is very quickly and easily done. Having gone through the mill, some four years ago, I undertook experiments in an attempt to lessen the labor of the process, which resulted in the following plan, first published in the Journal of Applied Microscopy in June, 1898, Volume I, No. 6. This method I have used and taught ever since with the best results. Its only drawback is that it requires the use of an autoclave, but as this piece of apparatus is now found in all well appointed laboratories, it can hardly be considered a great disadvantage. To make one liter of agar-agar take

A. Dried peptone (1 per cent.), 10 grams.
Common salt (.5 per cent.), 5 grams.
Liebig Beef ext. (.5 per cent.), 5 grams.
Water, 500 cc.
Boil for three minutes and neutralize.

B. Agar-agar (1.2 per cent.), 12 grams.
Water, 500 cc.

Chop the agar and put into autoclave. Run autoclave up to two atmospheres of pressure, giving 135.10 C. of heat. As soon as this pressure is reached, turn out the flame, and allow the autoclave to cool until below 100° C. before opening. The two solutions A and B are then mixed, cooled to 60° C., the whites of two eggs beaten in 50 cc. of water added, well stirred in, and the whole then boiled for three to five minutes and filtered through paper.

The entire process requires only an hour and a quarter to an hour and a half, and the result is a most excellent jelly. Instead of the

whites of eggs, blood serum may be used, which seems to add also to the nutritive value of the medium. Agar made with meat extract will often form a precipitate during the sterilization, which is objectionable if one wishes to use it in the pouring of Petri dishes, or the making of Esmarch's roll tubes.

To make an absolutely and permanently clear agar fresh meat should be used as follows:

To make one liter, take

A. Chopped meat, 500 grams.
Water, 500 cc.

Mix and place in cool place over night, then strain through towel.

B. Agar-agar (1.2 per cent.), 12 grams.
Water, 500 cc.

Put in autoclave, run up to two atmospheres of pressure, put out flame, and allow to cool until below 100° C. before opening. Let the solution of agar cool still further to about 75° C., and then thoroughly mix A and B, add (1 per cent.) 10 grams dried peptone and (.5 per cent.) 5 grams common salt, bring to a boil for three to five minutes, neutralize and filter. The product is an absolutely clear jelly, which never forms any precipitate. The whole process, with the exception of the time the meat is steeping, requires only about one hour and a half. In both of the above methods of making agar, the filtration is very quick—from seven to ten minutes for the liter. I never use a hot water funnel, but wet the filter paper with boiling water immediately before pouring in the agar. In the process with fresh meat the clarification is effected by the coagulation of the albumen in the meat water, hence solution B must not be added to A until cool enough to avoid coagulation. In general the fresh meat is to be recommended and the process is easier than with the meat extract, though the latter has the advantage of cheapness, and convenience, since the meat extract can always be kept on hand, and the time lost in soaking the fresh meat is saved.

The question which naturally arises as to whether 500 cc. of water will extract the same amount of material from 500 grams of beef, as a thousand cubic centimeters will, has been satisfactorily answered by the experiment of Dr. Harrington as given by Hill in the Journal of Applied Microscopy, March 1899, Vol. II, No. 3, showing that the difference is so slight that it may be entirely disregarded.

Having tried a number of different filter papers I have settled down to the exclusive use of Schleicher and Schull's number 597. This paper requires care in handling but gives the most rapid results of any that I have used.

OUTLINE OF THE WORK CARRIED ON IN THE NEW YORK STATE PATHOLOGICAL LABORATORY ON THE ETIOLOGY OF CANCER.

By HERBERT D. PEASE, M. D., Buffalo, N. Y.

Mr. Chairman and Gentlemen—Since arriving in Minneapolis I have been asked by many if I were not going to say something about the work being carried on in the New York State Laboratory for the investigation of cancer. You will readily understand that such an extensive piece of work as we have there undertaken, proceeds at a very slow pace and that, while many facts of great interest may be brought out from time to time, their chief value is only seen or appreciated when the whole cycle is complete and each separate observation is found to fit into its proper place and thus form the completed work.

Our work at present is in this individualized condition. We have observed and recorded many facts, the relative value of which, in the solution of the whole problem, is impossible to state at this time. I shall therefore confine most of my remarks to a general outline of our plan of attack and our methods of working.

In the spring of 1898, through the influence of Dr. Roswell Park, the State of New York appropriated to the Medical Department of the University of Buffalo $10,000 for the establishment of this laboratory and increased the appropriation to $15,000 for the present year.

The following plan for the work was agreed upon by the pathologist, Dr. H. R. Gaylord, and myself early in the summer of 1898. It seemed desirable to repeat, to some extent at least, the work already done by many previous investigators along this line, more especially that of Shattuck, Plimmer, Russell, Sanfelice, Roncali, Pianase, and others.

From the pathological standpoint this work consisted of, first, the histological examination of tumors according to the special methods described by some of the English and Italian workers for the purpose of demonstrating their so-called "cancer bodies." Second, the inoculation into lower animals in various ways of portions of cancerous growths of man and, when procurable, of animals. It also seemed desirable to introduce, as a matter of routine procedure, the examination of scrapings or fluid exudations from these tumors in their fresh condition. This important part of pathological procedures having been employed but little by other investigators in this line. From the bacteriological standpoint this work consisted in the examination of fresh stained and unstained and dried stained cover-glass preparations

of the diseased tissues, and the inoculation into the usual standard culture media of small portions of tumors in the following manner:

Portions of the surface of a tumor having been thoroughly burnt by means of a red hot section lifter, small pieces of the growth extending from the surface inward were cut out with a knife sterilized in the free flame, removed with sterile forceps and cut into in many places with sterile scissors. These pieces were then dropped into the culture media. From time to time other culture media were introduced, so that in many cases inoculations were made into large numbers of different kinds of media. Outside of the ordinary beef broth, agar, gelatine, potato, milk and beer wort which were prepared in two or more sets having different reactions running from 1.5 per cent. acid to .5 per cent. alkaline, the following were used: Human ascitic fluid, fluid horse serum, hay, cabbage, lettuce and bean stem decoctions, broth made from human muscle, solutions of various carbohydrates in water, and also in bouillon, and a semi-solid medium made with so-called Iceland moss in water and in beef broth. In most instances the reaction of these media was recorded but not changed, but in others, particularly the sugar media, the reactions were standardized at various points from 5. per cent. acid to .5 per cent. alkaline.

The media were generaly used in test tubes, but often various kinds and sizes of flasks containing larger amounts of from fifty to two hundred cubic centimetres were inoculated with large pieces of cancerous tissues. After inoculation the tubes were usually placed in the incubator at 37° C., but many were left at the room temperature. Others were placed under anaerobic conditions, the method of Buchner being the one chiefly used.[1]

Regarding the results of the pathological work I will say but little. Our observations were in harmony with those of other observers in the main. We have, however, refrained from drawing any definite conclusions from them.

From the inoculation of animals with cancerous tissues, what seems to be a positive result was obtained in one instance by the intravenous injection of a guinea pig with the peritoneal fluid from a case of colloid carcinoma of the peritoneum, which had been ten days in the incubator at 37° C. At the end of three and a half weeks the animal was killed and a nodule was found in its lung which, upon examination, proved to be an adeno-carcinoma. The examination of fresh cancerous tissues showed the presence in all cases of highly refractive, well defined, oval and round bodies occurring singly and in pairs, and at times in masses. They varied much in number and in size. Undoubtedly many were fat droplets, but an immense amount of labor with the use of fat solv-

[1] A description of the method of recording the details of this investigation will be found at the end of this paper.

ents and stains have proved futile in results which would permit us to decide as to their nature.

The results of the bacteriological work were like those of previous investigators, largely negative. All ulcerated tumors and those connected with mucous surfaces exposed to contaminating bacteria usually contained a rich flora.

Some non-ulcerated tumors or their metastases and the peritoneal exudates, in cases of carcinoma of the peritoneum and liver, contained at times micrococci. In several instances these micrococci showed peculiar morphological characters, and much time and labor was spent in comparing them and in making animal inoculations with them, but the significance of their presence in their respective tumors is as yet undetermined. A very few microorganisms other than bacteria presented themselves in the cultures or slides in the course of the work, but as yet little has been done with them.

Our attempts to cultivate blastomycetes from carcinomata have been entirely negative. This, however, has not by any means led us to think that there is no possibility of yeasts having some etiological relation to cancer. Plimmer, Sanfelice and others claim to have obtained cultures of yeasts in media when sown with cancerous tissues. Plimmer describes bodies present in over eleven hundred out of thirteen hundred cases of cancer examined by him after treating the tumors by a special hardening and staining method adapted by him to this work. He also has demonstrated the presence of similar bodies in the tissues of animals inoculated with cultures of yeasts isolated from human cancer. These bodies are round or oval, well defined, slightly stained, intracellular, and occur singly or in pairs, and many show one or more deeper staining central points. They present a considerable regularity as to size, but vary greatly in numbers in different tumors and different portions of the same tumor.

Sanfelice claims to have succeeded in producing cancer in at least one dog by the injection of a yeast, obtained from the skin of a lemon, into the mammary glands, after the yeast had been passed through the bodies of several dogs. He has also stated that when this yeast was in a condition to produce the tumor formation he was not able to obtain it again from the body of the animal.

Cassagrandi has also stated that yeasts may be present in the bodies of rabbits for a long period after inoculation with them, and yet attempts to reclaim them will generally fail, and he has devised a medium on which he says yeasts accustomed to the tissues of the animal body will grow. Attempts to obtain growths of yeasts on Cassagrandi's medium when sown with cancerous material were not successful in my hands.

As you are all aware many bacteria are profoundly altered morphologically and physiologically by what seem to be slight changes in their environment, and it is altogether probable that yeasts, at least many of them, are like the bacteria in this respect. Indeed it could hardly be otherwise, reasoning from the facts already well known concerning the life history of some yeasts. Brefeld and others have shown that a large number of micro-organisms of this class are but a stage in the life cycle of higher fungi. The spores of many higher fungi, especially those of some the Ustilagineæ, when sown on artificial culture media, grow out as yeasts and never develop their higher forms on such media. It can therefore be readily understood, that, if one should obtain yeasts on culture media sown with cancerous tissues, we would still be entirely without information as to its original source and character.

More exact information concerning the life history and proper position in the botanical system of yeasts and indeed also of bacteria would undoubtedly be of the greatest value in the investigation of problems concerning the etiology of disease. I would like, however, to speak strongly in favor of much work in the near future on careful descriptions of various common and uncommon bacteria, yeasts, and lower or incomplete fungi, under known conditions, without attempts at classification except for the sake of temporary convenience.

In closing I desire to say that I can only consider this talk as a very incomplete resumé of our work, but trust that it will give you some idea of our aims and stimulate your interest in our endeavors.

METHOD OF RECORDING THE PROCEDURES, OBSERVATIONS AND RESULTS OF THE INVESTIGATION INTO THE ETIOLOGY OF CANCER.

In research bacteriological and pathological work, where it is essential that all the conditions under which results are accomplished should, as far as possible, be known, it is necessary to have some ready means of making all details of proceedings and results a matter of record. This can very readily be accomplished by the use of the card catalogue system. The following adaptation of this system was devised for, and adopted by, the New York State Pathological Laboratory for its method of recording the details and results of the investigation into the etiology of cancer.

In order to simplify the description of this system, the order in which the cards are brought into use for each case will be observed. The card used for recording the preparation of the culture media will naturally come first. The card is blue in color with black printing. (See Card A):

Medium **No.** **Date,**

Meat

Muscle Sugar

Peptone **Salt**

Reaction

Sterilized

Stored

Special

[CARD A]

As soon as the tumors or other materials removed by operation or at autopsy are received, a white card with black printing is filled out. (See Card B):

Case[1] **Date** **Name**

Sex **Age**

Clinical Memoranda

[CARD B]

[1] On all the cards after the word case, is placed the original number of that case.

As many of these as are necessary can be used for the clinical data and can always be added to without inconvenience. These cards are also used to record details of the preparation and the precautions taken in the handling of the tumor before the bacteriological manipulations. The general description of the tumor and its preparation for sectioning is recorded on another white card printed in black. (Card C):

Macroscopic Data of Case

Organ **Total Blocks**

Location

Hardened

[CARD C]

The first work on the material for investigation was the sowing of tubes or flasks of the various culture media with portions of the tumors.

The records of this are made on a pinkish card printed in black. (Card D):

Case **Culture** **Date**

Medium

Inoculation

Incubator

Examination

[CARD D]

The cases are numbered. The cultures are lettered, A, B, C, D, etc. If more tubes are sown than there are letters in the alphabet, the letters are doubled as follows: AB, BC, CD, etc. Inoculations made from a culture to a fresh tube are labeled as follows: A—1, A—2, etc., and from this generation to fresh tubes would be designated A—1—A, A—1—B, A—2—A, A—2—B. The medium used for a culture is recorded on this card by its number and its constituents, and reaction is indicated by initials and signs, for example: NB = neutral bouillon; + 15 A = acid fifteen agar (Fuller's scale). On the next line is recorded the location, size, and nature of the material used for inoculating the tube. As a registering thermometer is kept in the incubator at all times, the noting on the cord, the dates of entrance and removal of the culture from the oven gives a record of the temperature to which it has been subjected and its duration. On this line is also indicated whether the culture is under aerobic or anaerobic conditions.

If an animal is inoculated with diseased tissues or with pure cultures, subsequent inoculations into culture media from its tissues at operation or autopsy are labeled according to this plan: Pig V—A or A—6—B—4—Pig X—A, etc.

Slide	**Case**	**Tissue**
Hardened		
Embedded		**U**
Stain		

[CARD E]

On the tubes or flasks corresponding to the cards are placed labels showing the case number, the alternate letter and number, designation of the culture, the date and the number and constituents of the medium.

Thus we know at a glance the origin, generation and age of the culture and the medium on which it is living, and the same information in greater detail is on record. The preparation of these culture cards and

labels is a very simple matter and is an absolute safeguard against subsequent confusion of the tubes.

The record of the preparation and examination of fresh stained or unstained slide or cover-glass preparations is made on a light buff colored card with black printing, which is also used for recording the preparation and examination of slides made from the hardened tissues. (Card E):

The printing on all the above cards is with black ink. Another set on which the printing is green but otherwise the same in colors and in wording is used for recording the experimental work on animals and their tissues. For example, if a guinea pig is inoculated the record is made on a card similar to B but printed in green.

The animals are numbered with Roman numerals. At the time of inoculation duplicate tags are filled out corresponding to the data on this card. One is placed on the cage in the animal house, and the other is hung on a hook on a chart of the animal house kept in the laboratory.

Upon the death of the animals cards like C, D, and E, but printed in green, are used for the autopsy notes, cultures and slide preparations respectively.

The most valuable feature of this system for such work is that as each card represents a unit they can be rearranged with but little trouble to conform to changes in plans which always occur. Other advantages are, that blank cards can be so distributed around the laboratory as to be always at hand when one desires to record an observation, and they can be put in their proper places at any time. Any number of cards can be removed from any part of the file and kept together for any length of time; for example, when cultures from different cases are being compared, and later returned without disturbing the sequence.

MODIFICATIONS OF THE POSTAL REGULATIONS RECOMMENDED BY THE COLORADO STATE BOARD OF HEALTH.

By Dr. G. E. TYLER, Denver.

"Specimens of diseased tissues may be admitted to the mail for "transmission to United States, State, or municipal laboratories, only "when inclosed in mailing packages constructed in accordance with the "specifications hereinafter enumerated.

"Upon the outside of every package shall be written or printed the "words, 'Specimen of Bacteriological Examination. *Immediate. By* " *'authority of the Postoffice Department (date), this package will be treated* " *'in all respects as letter mail.'* No package containing diseased tissue "shall be delivered to any representative of any of said laboratories "until a permit shall have first been issued by the Postmaster-General "certifying that said institution has been found to be entitled, in accord-"ance with the requirements of this regulation, to receive such speci-"mens.

"Specifications for the construction of packages for safely conveying "through the mails pathological specimens for bacteriological examina-"tion for diagnosis in cases of suspected diphtheria, tuberculosis, and "other communicable diseases:

SPECIFICATIONS FOR PACKAGES.

"(1) The receptacle for moist specimens of diseased tissues shall be "a strong glass vial *or test tube* having a capacity not greater than two "drams. Said vial shall be covered and made water-tight by the use "of a metal screw cap and a rubber or felt washer which has been im-"mersed in melted paraffine, *or, if a test tube be used, it shall be covered* "*with a tightly-fitting rubber cap.*

"(2) Said vial shall be placed inverted in a circular tin box. Said "box shall be made of I. C. Bright tin-plate, and shall have flush or "countersunk bottom and soldered joints, and shall *not be larger than* "*two and one-fourth inches in diameter, and three and one-half inches in* "*length.* This box shall be closed by a metal screw cover and rubber "or felt washer, *or, with a tightly-fitting metal sliding cover*, and it shall be "so packed with absorbent cotton that the glass vial contained in said "tin box shall be evenly surrounded on all sides by said cotton and the "cotton shall be closely laid.

"(3) Said tin box shall be placed inverted inside of a larger tin box "similar to the one already described, but measuring not less than *one*

"*inch* in diameter and not less than four or more than *six* inches in "length. Upon the inside of the sides and bottom of this outer tin box "there shall be a lining of compressed paper not less than three-six-"teenths of an inch in thickness. Said outer tin box shall be closed by "a metal screw cap and rubber or felt washer. *Or, this outside box may "consist of a block of hard wood, not less than one and one-half, or more "than three inches in diameter, and not less than four, or more than six "inches in length, said block having a cylindrical hole bored in one end, not "less than three-fourths, or more than one inch in diameter, and extending "to within not less than one inch of the opposite end. When a specimen is "inclosed, said hole shall be hermetically stopped with a tightly-fitting "wooden cork, immersed in melted paraffine, which cork shall not be again "removed until it has reached its destination.*"

This subject was referred to a special committee for consideration.

It frequently happens, in the work of the Colorado State Board of Health, that a specimen for bacteriological examination reaches Denver in the afternoon, but by reason of being treated as fourth-class mail matter, it is not delivered until the following day. If it were treated as letter mail, it would reach the laboratory during the afternoon, the specimen could be placed in the incubator, and a report could be made before noon of the following day. In a State as large as Colorado, where the specimens have already required considerable time to reach Denver, this further delay not only delays the diagnosis, in proportion to the number of hours apparently represented, but it may also spoil the specimen for examination. The words which are suggested to be placed upon the label are those now placed upon the weekly weather bulletins, and it is certainly of as great importance to have bacteriological specimens delivered immediately as to have the weather bulletins so treated.

The present regulations necessitate the use of a much wider receptacle than is necessary, and of a shorter one than is convenient. The change in dimensions will allow the use of a swab of different proportions, which is far more desirable, and it will also reduce the bulk and weight of the package, and thus lessen the expense of sending. This will encourage a more universal use of bacteriological methods by physicians in sparsely settled districts.

The mailing tubes now required are no safer than the one our Board has in mind. We expect to substitute a test tube for the inside vial, and this test tube, when packed in cotton, is no more liable to be broken than is the bulkier vial. The rubber cap for the test tube makes as good a safeguard as does the metal screw cap now in use. A test tube with a rubber cap has given excellent satisfaction to the Chicago Health Department, and the idea was borrowed from them. The mid-

dle receptacle now required differs from the one contemplated only in dimensions and in making the screw cap obligatory. It has been found that the screw cap frequently gets loosened in transit, and soon wears out. We expect to substitute for these screw caps a tightly-fitting metal cover, and believe it would prover safer and more durable. Instead of the outer tin box required under the present regulation, we expect to substitute a block of hard wood. This block is to have inserted a cork dipped in melted paraffine, and it will therefore be an absolute safeguard against the escape of disease germs. We have found that the cover to the outer box under the present regulations, sometimes gets displaced, and it wears out very quickly, being a source therefore both of danger and of expense for renewal.

The amended regulations will allow us to purchase mailing tubes at a cheaper rate than the present regulations, and the first cost, as well as the shipping cost, will therefore be reduced.

It will be noticed that the amendments suggested do not interfere in any way with the continuation of the mailing cases now in use, and so no hardship will occur to any one by the change.

NOTE.—Amendments are indicated by italics.

NOTES ON THE REACTION AT WHICH THE MAXIMUM GROWTH OF BACTERIA OCCURS IN LIQUID MEDIA.

By EZRA H. WILSON, M. D., Director Bacteriological Department, Hoagland Laboratory, and R. B. F. RANDOLPH.

When this work was begun it was thought likely that if a simple, accurate, and fairly rapid method could be devised to determine the reaction at which maximum growth of bacteria in liquid media takes place, such a method would find a place among the many already in use for differentiating between bacterial species. Our expectations have not been realized. The method given in this paper is neither simple, accurate, nor rapid, and so far we have failed to obtain results of value although a great deal of work has been done. Certain facts have been brought to light, however, which bear on this and allied work, which we believe to be of interest, and we therefore publish our results at this time, not because we have anything new to offer but to invite suggestions and to interest others in what we believe to be a promising field for research.

The starting point of all bacterial work is necessarily the culture media employed. A perfect medium should conform to the following requirements:

1. Bacteria must grow on it readily.
2. It should be of definite composition which should be as simple as possible and capable of exact duplication.
3. All components should be readily determinable by chemical analysis.
4. The reaction should be that most favorable to bacterial growth.
5. It should permit of sterilization without change in its chemical or physical properties.
6. It should not be affected by time, light, etc.

No medium is known which conforms to all these requirements and it is possible that none will ever be discovered, but in the preparation of our media we have kept the above requirements in view and have endeavored to approach them as nearly as possible.

The methods used have in the main been those of the Bacteriological Committee. We have, however, used 10 c.c. of medium and a N—10 Na OH solution for titration because greater accuracy can be secured thereby. The neutral point used is a faint but true pink. At this point the most closely agreeing results were obtained. Meat extract (Liebig) was used instead of meat infusion, as our object was to secure the

greatest uniformity possible. All the extract was of one lot and had been carefully mixed to secure uniform distribution of salt, and kept in the ice chest. It contained no fermentable material and the troublesome removal of sugar by B. coli was therefore avoided. Witte's pepton and Merck's c. p. sodium chlorid were used. All media were made in distilled water. The method used is as follows:

Five grammes of meat extract, 10 g. of pepton, and 5 g. of salt are carefully weighed out and dissolved in one litre of distilled water and placed in the inner chamber of an enamelled double boiler, the outer chamber of which is filled with a 50 per cent. solution of calcium chlorid, the boiling point of which is 112.5 C. This solution is heated to boiling before the introduction of the distilled water in the inner chamber in order that the medium will heat as rapidly as possible. The medium soon boils and is allowed to boil vigorously for fifteen minutes. The inner chamber containing the medium is then removed, the outside rinsed to remove the calcium chlorid, allowed to cool to 60 C. and weighed with its contents. The loss of water is then made up by adding cold distilled water until the medium weighs 1000 g. The temperature of the medium is now at or near 50 C. When it reaches this point three lots of 10 c.c. each are withdrawn for titration. The reaction having been established enough normal Na OH is added to make the solution neutral to phenolphthalein. It is then boiled for fifteen minutes, made up to 970 g. and filtered through a folded filter which has been thoroughly moistened with boiling water. The filtrate is received in a tared flask, weighed, cooled to 50 C. and titrated. Enough normal HCl is added to bring the reaction to the desired point and it is then titrated to verify the reaction. The remainder of the solution is tubed from a burette as quickly as possible and sterilized for thirty minutes on three successive days.

By this method of setting the reaction it is possible to have the finished product within 0.05 per cent. of the required reaction.

The changes in volume occurring during sterilization are so small as to be negligible, the average error in a set of twelve experiments being 0.27 per cent. after three sterilizations. It has been found that, when B. coli communis is used, the number of individuals in a culture is independent of the number sown. Nevertheless it has been our practice to sow as nearly uniform numbers as possible. It has also been found desirable to avoid the use of a large number of pipettes as they differ considerably among themselves; we therefore use one pipette for an entire experiment, sterilizing it by immersion in boiling water for one minute. Numerous controls show this method to be efficient for non-sporulating bacteria.

Great trouble has been experienced in getting uniform distribution of bacteria in the dilution flasks. In spite of the shaking they receive very discordant results are frequently obtained.

This is the most serious error in the work and we have been unable to reduce it sufficiently to obtain concordant and trustworthy results. An error also occurs in counting plates and this increases rapidly with an increase in the number of colonies on a plate in excess of 500. We have given Neisser's method of microscopic counting a thorough trial and are convinced that if uniformity of distribution in the dilution flasks can be obtained, that much greater accuracy will result if plates obtained by the use of high dilutions and containing not more than 500 colonies are used.

The method of determining maximum growth is as follows:

Broth is made after the standard method up to the point where the final reaction is adjusted; after filtration the medium is distributed in lots of 150 c.c. in Erlenmeyer flasks, and calculated amounts of acid and alkali added to these lots to bring them to the desired reactions. The temperature being maintained at as near 50 C. as possible, samples are withdrawn and titrated in the usual way and the medium is then tubed, 5 c.c. in those tubes intended for experimental purposes, and 10 c.c in those used for titration. Usually six tubes containing 5 c.c. and nine containing 10 c.c. are thus prepared. They are then sterilized by the standard method and kept in the ice chest to avoid evaporation and changes in the medium. To insure uniformity in the number and vitality of the bacteria to be planted in these tubes a culture is made in broth, R. 1.0 per cent., and kept for twenty-four hours at 37.5 C. One c.c. of this culture is then diluted with 99 c.c. of sterile water and one drop of this dilution aded to each tube to be tested. The tubes are placed in the incubator at the desired temperature (usually 37.5 C.) and allowed to remain for the desired time. They are then removed and immediately placed in a bath of iced water to prevent further growth. In the meantime sufficient gelatin (so prepared that 7 c.c. when diluted with 1 c.c. of water will correspond with standard gelatin, R. 1.2 per cent.), has been melted and kept at 40 C. in a water-bath. One c.c. of culture is then taken from each tube after thorough shaking (the tube being shaken 100 times) by means of a sterile pipette and transferred to a flask containing 99 c.c. of sterile water. This is shaken vigorously 100 times to insure thorough admixture and 1 c.c. transferred to 99 c.c. of sterile water as before. Usually three such dilutions are required to obtain plates containing few enough colonies to be readily counted. From the second and third dilutions, 1 c.c. is taken and run into the middle of a sterile Petri dish, 7 c.c. of gelatin poured on it and thoroughly mixed with it by tilting the dish. The dish is then placed on a levelled plate which has been cooled to near 0 C. by means of ice, and

allowed to set as rapidly as possible. These plates are then kept in the cool incubator at 20 C. for forty-eight hours and counted.

The work already done which is accurate enough to be recorded comprises two sets of experiments on S. P. aureus, six on B. coli communis, and two on B. typhosus. It is impossible in an abstract of this length to give the results in detail. The media used varied in reaction from + 3.0 per cent. to — 2.0 per cent., a series usually comprising twelve different lots of media differing by about 0.4 per cent.

The first two of these series of experiments, those with S. P. aureus, were made before the microscopic method of counting plates had been sufficiently perfected to allow of its use. The plates are therefore all made from the third dilution. Two plates were made for each dilution and each plate was counted four times. The number of results is sufficient to show that with dilution of 1—1,000,000 and with this particular organism, plates having a convenient number of colonies for ready and reasonably accurate counting can be obtained after twenty-four hours incubation of the cultures. The results agree very well, better, in fact, than any of our subsequent ones. This may be attributed partly to the ease of securing a uniform suspension of this organism, thus insuring accuracy of dilution, and partly to the very favorable character of the plates, the number of colonies being large enough to render an error of four or five relatively unimportant, and small enough to count well within this error. The optimum point for this organism lies near 1.0 per cent. Good growth occurs through the whole alkaline series, and also in the acid one until a reaction of 2.0 per cent. is reached. Beyond 2.0 per cent. a decided falling off is noticed, and at 2.5 per cent. the inhibition is so great that the first dilution plate only showed twenty colonies, and these developed more slowly than others on plates from media less acid, showing that even the organisms that grew had been affected by the acidity of the medium.

As the behavior of B. coli communis toward media of acid reaction has long been a matter of interest and importance from a diagnostic point of view, this organism was used for most of the work. Three series of experiments were made with this bacillus, all of them being repeated to increase the accuracy of the results. The reaction corresponding to the maximum growth of this organism is at or near 0.5 per cent., a result which is surprising when the statements made by many observers regarding the suitability of acid media for this organism are taken into consideration. Good growth occurs on the acid end of the series as far as 1.72 per cent., beyond this point the rapidity of growth begins to diminish quickly, and at 3.0 per cent. no multiplication takes place. The difference in time of the experiments affects the results not so much as regards the point of maximum growth, which remains

nearly constant, but the growth at the extremes of the series, which is relatively better compared with the maximum in the long experiments than in the short ones. The results on B. typhosus are practically identical with those on B. coli. The diminution is more sudden on both ends of the scale, and the actual rate of growth is much slower than that of B. coli. The optimum is at or near + 0.4 per cent.

It is not possible, however, to make serviceable comparisons of the rates of growth, as shown by this series of experiments, for inasmuch as the rates must be compared by comparing a series with another series made at a different time, uniformity of conditions could not be satisfactorily maintained.

RECAPITULATION.

In order to determine, even approximately, the proper reaction for favorable growth, it is necessary that complete uniformity of methods and accurate control of every detail be obtained. The most serious error in the method used, is that due to uneven distribution of bacteria in the original culture and in the dilution flasks.

This error must be reduced before results which are accurate enough to be of value can be obtained.

If this error can be brought within reasonable limits, greater accuracy can be obtained by counting thinly sown plates obtained by the use of high dilutions, than by counting thickly sown plates microscopically.

The reaction at which maximum growth of S. P. aureus occurs in standard broth is in the neighborhood of + 1.0 per cent., of B. coli communis between + 0.8 per cent. and + 0.5 per cent., and of B. typhosus between + 0.92 per cent and + 0.4 per cent. Further experimental work is necessary to establish these results. No conclusions can be drawn from the results obtained as regards the comparative rates of growth of these different organisms, as experiments apparently exactly alike on the same organism give widely different rates.

The number of bacteria (within limits) sown in a tube of broth has no effect on the number contained after growth has taken place, provided the time during which growth takes place is not too short.

LOMB PRIZE ESSAY.

INTRODUCTION.

As the result of prizes offered by Mr. Henry Lomb, of Rochester, N. Y., through the American Public Health Association, the following awards were made at the meeting of the Association, held in the city of Washington in 1885.

I. HEALTHY HOMES AND FOODS FOR THE WORKING CLASSES. By VICTOR C. VAUGHAN, M. D., PH. D., Professor in University of Michigan. Prize $200

II. THE SANITARY CONDITIONS AND NECESSITIES OF SCHOOL-HOUSES AND SCHOOL-LIFE. By D. F. LINCOLN, M. D., Boston, Massachusetts. Prize $200

[1] III. DISINFECTION AND INDIVIDUAL PROPHYLAXIS AGAINST INFECTIOUS DISEASES. By GEORGE M. STERNBERG, M. D., Major and Surgeon U. S. Army. Prize..... $500

IV. THE PREVENTABLE CAUSES OF DISEASE, INJURY AND DEATH IN AMERICAN MANUFACTORIES AND WORKSHOPS, AND THE BEST MEANS AND APPLIANCES FOR PREVENTING AND AVOIDING THEM. By GEORGE H. IRELAND, Springfield, Massachusetts. Prize..... $200

That these essays may be placed in the hands of every family in the country is the earnest desire of the Association, as well as the heartfelt wish of the public-spirited and philanthropic citizen whose unpretentious generosity and unselfish devotion to the interests of humanity have given us these essays, but the financial inability of the Association renders it impossible to distribute them gratuitously;—therefore a price covering the cost has been placed upon these publications. It is to be hoped, however, that government departments, state and local boards of health, sanitary and benevolent associations, etc., will either publish these essays, or purchase editions at cost of the Association, for distribution among the people.

Although a copyright has been placed upon these essays for legitimate protection, permission to publish, under certain conditions, can be obtained by addressing the secretary.

[1] Revised in December, 1899, by the Author.

DISINFECTION AND INDIVIDUAL PROPHYLAXIS AGAINST INFECTIOUS DISEASES.

By GEORGE M. STERNBERG, M. D., L.L. D., Surgeon-General U. S. Army.

[Revised in December, 1899, by the Author.]

INTRODUCTION.

Definition. We are met at the outset by a difficulty growing out of the fact that the word *disinfection*, as commonly used, has a very different signification from that to which certain authors would restrict it. Thus, the Committee on Disinfectants of the American Public Health Association defines a disinfectant as "an agent capable of destroying the infective power of infectious material."[1] In the preliminary report of this committee the reasons for restricting the meaning of the word within the limits justified by its etymology, and of our knowledge of the nature of "infectious material," are very clearly stated, as follows:

"The object of disinfection is to prevent the extension of infectious diseases by destroying the specific infectious material which gives rise to them. This is accomplished by the use of disinfectants.

"There can be no partial disinfection of such material: either its infecting power is destroyed, or it is not. In the latter case there is a failure to disinfect. Nor can there be any disinfection in the absence of infectious material. * * *

"Popularly, the term disinfection is used in a much broader sense. Any chemical agent which destroys or masks bad odors, or which arrests putrefactive decomposition, is spoken of as a disinfectant. And in the absence of any infectious disease it is common to speak of disinfecting a foul cesspool, or a bad-smelling stable, or a privy vault.

"This popular use of the term has led to much misapprehension, and the agents which have been found to destroy bad odors—deodorizers,—or to arrest putrefactive decomposition—antiseptics—have been confidently recommended and extensively used for the destruction of disease germs in the excreta of patients with cholera, typhoid fever, etc.

"The injurious consequences which are likely to result from such misapprehension and misuse of the word disinfectant will be appre-

1 *The Medical News*, Phila., Jan. 24, 1885, p. 87.

ciated when it is known that recent researches have demonstrated that many of the agents which have been found useful as deodorizers, or as antiseptics, are entirely without value for the destruction of disease germs.

"This is true, for example, as regards the sulphate of iron or copperas, a salt which has been extensively used with the idea that it is a valuable disinfectant. As a matter of fact, sulphate of iron in saturated solution does not destroy the vitality of disease germs, or the infecting power of material containing them. This salt is, nevertheless, a very valuable antiseptic, and its low price makes it one of the most available agents for the arrest of putrefactive decomposition in privy vaults, etc.

"Antiseptic agents also exercise a restraining influence upon the development of these germs, and their use during epidemics is to be recommended when masses of organic material in the vicinity of human habitations cannot be completely destroyed, or removed, or disinfected.

"While an antiseptic agent is not necessarily a disinfectant, all disinfectants are antiseptics; for putrefactive decomposition is due to the development of 'germs' of the same class as that to which disease germs belong, and the agents which destroy the latter also destroy the bacteria of putrefaction, when brought in contact with them in sufficient quantity, or restrain their development when present in smaller amounts.

"A large number of the proprietary 'disinfectants' so called, which are in the market, are simply deodorizers or antiseptics of greater or less value, and are entirely untrustworthy for disinfecting purposes."[1]

The offensive gases given off from decomposing organic material are no doubt injurious to health; and the same is true, even to a greater extent, of the more complex products known as *ptomaines*, which are a product of the vital—physiological—processes attending the growth of the bacteria of putrefaction and allied organisms. It is therefore desirable that these products should be destroyed; and, as a matter of fact, they are neutralized by some of the agents which we recognize as disinfectants, in accordance with the strict definition of the term. But they are also neutralized by other agents—deodorants—which cannot be relied upon for disinfecting purposes, and by disinfectants, properly so called, in amounts inadequate for the accomplishment of disinfection. Their formation may also be prevented by the use of *antiseptics*. From our point of view the destruction of sulphureted hydrogen, of ammonia, or even of the more poisonous ptomaines, in a privy vault, is no more disinfection than

[1] *The Medical News*, Apr. 18, 1885, p. 425.

is the chemical decomposition of the same substances in a chemist's laboratory. The same is true as regards all of the bad-smelling and little known products of decomposition. None of these are "infectious material," in the sense in which we use these words; that is, they do not, so far as we know, give rise *directly* to any infectious disease. Indirectly they are concerned in the extension of the epidemic "filth diseases," such as cholera, yellow fever and of the fatal endemic filth diseases, such as typhoid fever and diphtheria, which in the long run claim more victims than do the pestilential maladies first named. This because persons exposed to the foul emanations from sewers, privy vaults, and other receptacles of filth, have their vital resisting power lowered by the continued respiration of an atmosphere contaminated with these poisonous gases, and are liable to become the victims of any infectious disease to which they may be exposed. Moreover, the accumulations of filth which give off these offensive gases furnish pabulum upon which certain disease germs thrive; and it may happen that the bad smelling air carries something worse than the poisonous gas which makes its presence known by offending the sense of smell. It may waft to our nostrils infectious particles which are beyond recognition by any sense, unless it be the sense of sight with the aid of a good microscope.

We desire, moreover, to have it fully understood that in restricting the meaning of the term disinfection within the limits given by the definition of the Committee on Disinfectants of the American Public Health Association, we do not wish to limit the practice of "disinfection," in the popular sense of the word.

It is but fair to say, also, that this popular usage is supported by good authority, and until quite recently has been the common acceptation of the term among physicians and chemists. Indeed, it is but a short time since the nose test was the only test of "disinfection" recognized by many intelligent persons.

Littré, in his Dictionary of the French Language, defines disinfectants as "substances which destroy, chemically, bad odors."

Vallin, the author of a valuable treatise upon "Disinfection and Disinfectants," says,—

"From a scientific point of view there is perhaps an impropriety in introducing into the idea of disinfection the suppression of odors which offend the sense of smell. The bad odor is not injurious in itself; it is an epiphenomenon, which does not necessarily give the measure of the hurtful properties of the air, or of any substance whatever. The public, unacquainted with medicine, has an unfortunate tendency to judge of insalubrity by the bad odor; the absence of this gives to it a deceitful security: when they are masked by any device,

it [the public] believes that all danger has been removed. *Nevertheless it is necessary to avoid violating the ordinary sense of words.*[1] An atmosphere which does not in the least offend the sense of smell may certainly be insalubrious, and engender the gravest maladies; but the fetid or disagreeable odors may reveal the presence of injurious principles, of toxic gases, or of organic matter in decomposition. We should not too much diminish the importance of these offensive odors in the eyes of the public; everything which smells badly is to be suspected."[2]

We agree with Prof. Vallin, that the bad odors should arouse suspicion, and lead to the use of deodorants, or of antiseptics, or of disinfectants, if required; but let us not leave the public to suppose that when the bad odors have been neutralized, the offensive material has been disinfected. Let us rather instruct the public that to deodorize and to disinfect are not synonymous terms. For our part we prefer to "violate the ordinary sense" of the word, and to restrict its signification within such limits as will prevent confusion, and, what is far worse, a reliance upon inefficient methods for the destruction of infectious material.

In the present essay we shall use the words disinfection and disinfectant, in accordance with the definition of the committee on disinfectants already given. But, inasmuch as this is intended to be a practical treatise for popular use, we shall also give, in the proper place, directions for the use of deodorants and of antiseptics, so that "disinfection," in the broad sense in which the word is commonly used, may be fully considered.

Tests of Disinfection. What means have we of proving that the infective power of infectious material has been destroyed?

Evidence of disinfection may be obtained (*a*) from the practical experiments—experience—of those engaged in sanitary work; (*b*) by inoculation experiments upon susceptible animals; (*c*) by experiments made directly upon known disease germs.

(*a*) It is a matter of common experience, that when a room has been occupied by a patient with an infectious disease, such as smallpox, scarlet fever, or diphtheria, susceptible persons are liable to contract the disease weeks or even months after the patient has been removed from it, unless in the meantime it has been disinfected. If a second case does occur from exposure in such a room, it is evident that it has not been disinfected. But the non-occurrence of subsequent cases cannot always be taken as evidence that the means of disinfection resorted to were efficient. Negative evidence should be

[1] Italics by present writer.
[2] Op. Cit., p. 2.

received with great caution. In the first place, the question as to whether susceptible individuals have been fairly exposed in the disinfected room must be considered. Then it must be remembered that susceptible persons do not always contract a disease, even when they are exposed in a locality known to be infected. A further difficulty in estimating the value of evidence obtained in practice arises from the fact, that, in connection with the special means of disinfection resorted to, such as fumigation, hanging up cloths saturated with a disinfecting solution, etc., it is customary to resort to additional precautionary measures, such as washing surfaces with soap and hot water, white-washing plastered walls, and free ventilation. It is apparent that under these circumstances it would be unsafe to accept the fact, that no other cases occurred in a room treated in this way, as evidence that the particular disinfectant used is efficient for the destruction of the infectious agent of the disease in question. The fond mother who attaches a charm to her child's neck to protect it from evil, also takes the precaution of guarding it from contact with other children who are sick with any infectious disease. If her child fortunately grows to manhood or womanhood without having suffered an attack of scarlet fever or diphtheria, she may imagine that her charm has protected it, but the evidence upon which her faith is founded is not of a nature to convince those who are familiar with scientific methods of demonstration. "Well educated" persons are often ready to testify in favor of methods of disinfection, or of treatment, upon evidence which, from a scientific point of view, has no more value than that which the fond mother in question has to offer in favor of the little bag containing camphor or assafœtida, or some other charm of equal value, which she has attached to her child's neck to keep it from catching scarlet fever or diphtheria at school. On a par with these charms, so far as disinfection is concerned, we may place the saucer of chloride of lime, which it was formerly the fashion to place under the bed of a patient sick with an infectious disease, the rag saturated with carbolic acid, or chloride of zinc, suspended in the sick-room, and even the fumigations with burning sulphur, as sometimes practiced by those who are unfamiliar with the evidence as to the exact value of this agent, and the conditions necessary to ensure successful disinfection with it.

Chloride of lime, sulphurous acid gas, and carbolic acid are among our most useful disinfecting agents, but disease germs are not to be charmed away by them any more than by a little bag of camphor.

Having pointed out the fact that negative evidence, in a restricted field of observation, must be accepted with great caution in estimating the value of disinfectants, we hasten to say that the combined

experience of sanitarians, derived from practical efforts to restrict the extension of infectious diseases, is of the greatest value, and that this experience is to a great extent in accord with the results of exact experiments made in the laboratory.

(*b*) Inoculation experiments upon susceptible aniamls, made directly with infectious material which has been subjected to the action of a disinfectant, have been made by numerous observers. The proof of disinfection in this case is failure to produce the characteristic symptoms which result from inoculation with similar material not disinfected. Thus, Davaine found that the blood of an animal just dead from the disease known by English writers as anthrax or splenic fever (Fr. *Charbon*), inoculated into a healthy rabbit or guinea-pig, in the smallest quantity, infallibly produces death within two or three days; and the blood of these animals will again infect and cause the death of others, and so on indefinitely. This anthrax blood therefore was infectious material, which could be utilized for experiments relating to the comparative value of disinfectants. Davaine made many such experiments, not only with the blood of anthrax, but also with that of a fatal form of septicæmia in rabbits, which is known by his name. Other investigators have followed up these experiments upon infectious material of the same kind, and also upon material from other sources—*e. g.*, the infectious material of glanders, of tuberculosis, of symptomatic anthrax, of fowl cholera, of swine plague, etc.

It has been proved that the infectious agent in all of the diseases mentioned is a living germ, and that disinfection consists in destroying the vitality of this germ. But in experiments made with blood or other material obtained directly from diseased animals, the results would be just as definite and satisfactory if we were still ignorant as to the exact nature of the infecting agent. The test shows the destruction of infecting power without any reference to the cause of the special virulence, which is demonstrated to be neutralized by certain chemical agents in a given amount. All of the experiments made with the above mentioned kinds of virus have been made upon the lower animals; but there is one kind of material which it is justifiable to use upon man himself, and with which numerous experiments of a very satisfactory character have been made. This material is vaccine virus. Fresh vaccine, when inoculated into the arm of an unvaccinated person, gives rise to a very characteristic result,—the vaccine vesicle. The inference seems justified that any agent which will neutralize the specific infecting power of this material will also neutralize the smallpox virus. Thus far it has not been definitely proved that the infective agent in vaccine virus is a living germ; but the numerous experiments made have shown that the chemical

agents, which have the power of destroying the various kinds of infectious material heretofore mentioned, have also the power, in about the same amounts, of neutralizing vaccine virus, as shown by its failure to produce any result when inoculated into an unvaccinated person. In these experiments the more careful investigators have taken the precaution of vaccinating the same person with disinfected and non-disinfected virus from the same source. A successful vaccination with the non-disinfected virus shows that the individual is susceptible, and the material good: failure to produce any result is evidence that the potency of the disinfected virus has been destroyed by the chemical agent to which it was exposed.

(*c*) As already stated, it has been demonstrated that the infectious diseases of the lower animals, which have furnished the material for experiments upon disinfectants by the method of inoculation, are "germ diseases," and that the infectious agent is in each case a living microorganism, belonging to the class known under the general name of *Bacteria*. The bacteria are vegetable organisms, which, by reason of their minute size and simple organization, must be placed at the very foot of the scale of living things. But they make up in number and in rapidity of development for their minute size; and there is good reason for believing that the infectious diseases of man are also caused by pathogenic—disease-producing—organisms of the same class. Indeed, this has already been proved for some of these diseases, and the evidence as regards several others is so convincing as to leave very little room for doubt.

Many of these disease germs are now known to us, not only by microscopic examination of the blood and tissues of infected animals, but also by "culture experiments." That is, we are able to cultivate them artificially in suitable media, and to study their mode of development, etc., in the laboratory, quite independently of the animals from which our "pure cultures" were obtained in the first instance. The culture fluids used are prepared from the flesh of various animals; and when to one of these a certain quantity of gelatine is added, we have a "solid culture medium," upon the surface of which some of these germs will grow most luxuriantly. To start such a "culture," it is only necessary to transfer, with proper precautions, a minute quantity of the infectious material to the surface of our culture medium, or into a fluid which has been found to be suitable for the growth of the particular organism which we desire to cultivate. A second culture is in the same way started from the first, and so on indefinitely.

Now it is evident that these "pure cultures" furnish us a ready means for testing the power of various chemical agents to destroy

the vitality of known disease germs, as shown by their failure to grow in a suitable culture medium after exposure for a given time to a given percentage of the disinfectant. Very many experiments of this nature have been made. The reader who desires fuller details as to the method of conducting such experiments, and of the results obtained, is referred to the preliminary reports of the committee on disinfectants, of the American Public Health Association, published in 1885 in the *Medical News*, Philadelphia, and also published in full in the annual volume of the Association for 1888. We may say here, that the experimental data on record indicate that those agents which are efficient for the destruction of any one of the pathogenic organisms upon which experiments have been made, or of harmless species of the same class,—*e. g.*, the bacteria of putrefaction,—are efficient for the destruction of all, *in the absence of spores*. There is, it is true, within certain limits, a difference in the resisting power of different organisms of this class to chemical agents. This is not, however, sufficiently marked to prevent the general statement that *a disinfectant for one is a disinfectant for all, in the absence of spores.*

The last clause of the above statement calls for an explanation, and certain details with reference to the mode of reproduction of disease germs. All of the bacteria multiply by binary division; that is, one individual divides into two, and each member of the pair again into two, and so on. The spherical bacteria, known as *micrococci*, multiply only in this way, but the rod-shaped bacteria, or *bacilli*, also form spores. These spores correspond with the seeds of higher plants. They are highly refractive, oval or spherical bodies, which, under certain circumstances, make their appearance in the interior of the rods, which cease to multiply by binary division when spore formation has taken place. The point of special interest with reference to these spores is, that they have a resisting power to heat, and to the action of chemical disinfectants, far beyond that which is possessed by micrococci, or by bacilli without spores. The difference may be compared to the difference between a tender plant and its seeds to deleterious influences, such as extremes of heat and cold. Thus the spores of certain species of bacilli withstand a boiling temperature for several hours, while a temperature of 150° Fahr. quickly kills most bacteria in the absence of spores. A similar difference is shown as regards the action of chemical agents. Certain agents,—*e. g.*, sulphurous acid gas and carbolic acid,—which are extensively used as disinfectants, have been proved by exact experiments to be quite impotent for the destruction of spores. This being the case, it is advisable, in practical disinfection, always to use an agent which has the power of destroying spores, in those cases in which the exact

nature of the disease germ has not been demonstrated. The cholera germ of Koch does not form spores; and there is good reason to believe that the same is true as regards the germs of yellow fever, of scarlet fever, and of small-pox, which have not yet been demonstrated. This inference is based upon evidence obtained in the practical use of disinfectants, and upon certain facts relating to the propagation of these diseases.

A second general statement, which is justified by the experimental evidence on record, is, that *agents which kill bacteria in a certain amount, prevent their multiplication in culture fluids, when present in quantities considerably less than are required to completely destroy vitality.*

An agent, therefore, which, in a certain proportion and in a given time, acts as a "germicide" in a smaller quantity, may act as an *antiseptic, i. e.,* may prevent putrefactive decomposition by restraining the development of the bacteria of putrefaction. Antiseptics also prevent or retard the development of pathogenic bacteria. It follows from this that germicides are also antiseptics; but the reverse of this proposition is not true as a general statement, for all antiseptics are not germicides. Thus alcohol, common salt, sulphate of iron, and many other substances which are extensively used as antiseptics, have scarcely any germicide power, even in concentrated solutions, and consequently would be entirely unreliable as disinfectants.

Practically, antiseptics may accomplish the same result in the long run as we obtain in a short time by the use of disinfectants. If, for example, we prevent the development of the germs of cholera, or of typhoid fever, in an infected privy vault, by the continued use of antiseptics, these germs will in time lose their ability to grow, when introduced in to a suitable culture medium. But in the meantime there is always the possibility that some of them may escape, with the fluid contents of the vault, into the surrounding soil, and contaminate some well or stream from which drinking-water is obtained. For this reason privy vaults, cesspools, and sewers should never be allowed to become infected. All infectious material, such as the dejections of patients with cholera or typhoid fever, should be destroyed at its source, in the sick-room; or, if it is ascertained that such material has been thrown into a privy vault, the entire contents of the vault should be promptly disinfected. The same rule applies to infectious material thrown upon the ground, or wherever it may be.

Finally, we desire to emphasize the following propositions:

Disinfection consists in extinguishing the spark, killing the germ, which may light up an epidemic in the presence of a supply of combustible material—filth.

The object of *general sanitary police* is to remove this combustible material out of the way, so that no harm may result even if the spark be introduced.

Antiseptics and deodorants are useful when it is impracticable to remove offensive organic material from the vicinity of human habitations, but they are a poor substitute for cleanliness.

PART FIRST.

DISINFECTION.

It will be our aim in the present chapter to give reliable, practical directions with reference to the use of disinfectants, and the best methods of disinfection. Keeping this object in view, we shall recommend for disinfecting purposes only those agents named in the following list:

1. Fire.
2. Steam under pressure (20 pounds).
3. Boiling water.
4. Formaldehyd gas.
5. Chloride of lime (in solution).
6. Mercuric chlorid (in solution).
7. Carbolic acid (5 per cent. solution).
8. Caustic lime ("quicklime").
9. Dry heat (230° Fahr. for two hours).
10. Sulphur dioxid.
11. Copper sulphate (in solution).
12. Zinc chlorid (in solution).

All of these agents, properly used, are effective for the destruction of the "germs" of the following named diseases: Tuberculosis, diphtheria, typhoid fever, yellow fever, cholera, small-pox, measles, pneumoina, epidemic influenza, erysipelas, hog cholera, chicken cholera, swine plague, infectious pleuro-pneumonia of cattle and, in general, of all infectious diseases in which the specific germ does not form spores. The five agents at the head of the list may also be relied upon for the destruction of the spores of anthrax, tetanus and symptomatic anthrax, which are the principal diseases in which it has been demonstrated that resistant spores are present in the infectious material by which they are propagated.

We shall first give a brief account of the conditions of successful disinfection with these agents, as established by experimental data, and afterward detailed directions for their employment under the various circumstances in which disinfection is required.

1. Fire. It is hardly necessary to say that burning of infectious material, infected clothing, etc., is an effectual method of disposing of it. This method of disinfection is always to be recommended, when practicable or consistent with a due regard for economy and the rights of individuals. As a rule, articles of little value, which have been soiled with infectious material, had better be burned; and this is especially true of old clothing and bedding. But we have other efficient methods of disinfection, which make it unnecessary to sacrifice articles of value except under unusual circumstances.

2. Steam under Pressure. The disinfecting power of steam given off from boiling water in an open vessel does not differ from that of the water itself, but confined steam has a temperature corresponding with the pressure as indicated by a steam gauge. At twenty pounds pressure the temperature is about 230° Fahr. (105° C.); at twenty-five pounds it is about 240° Fahr.; at thirty pounds it is 250° Fahr. Moist heat at the lowest temperature named destroys the most resistant spores in twenty minutes, while a temperature of 240° Fahr. is effective almost immediately

3. Boiling. In the absence of spores, bacteria are quickly killed at a temperature considerably below the boiling point of water, and it is safe to say that boiling for half an hour will destroy all known disease germs, including the spores of anthrax, which have less resisting power than the spores of certain harmless and widely distributed bacilli, which have been found to resist boiling for several hours.

As a matter of fact a temperature considerably below the boiling-point of water (140-160° Fahr.), destroys within a few minutes the germs of cholera, typhoid fever, diphtheria, pneumonia, erysipelas and many other known disease germs.

4. Formaldehyd Gas. Since the first edition of this "prize essay" was published (in 1886) the most valuable addition to our knowledge of disinfecting agents has been the discovery of the germicidal action of formaldehyd, and this gas is now largely used for the disinfection of clothing, hospital wards, etc., as a substitute for steam or for sulphur dioxid. But like these agents its action is superficial and it cannot be depended upon for the disinfection of mattresses, pillows, rolls of clothing or bedding, etc. As is the case with chlorine and sulphur dioxid its germicidal power is increased by the presence of moisture, and by a high temperature. By means of a vacuum chamber, in which the articles to be disinfected can be placed and the air exhausted prior to the admission of the disinfectant, the necessary penetration can be secured for such articles, when they are properly arranged. But disinfection of clothing and bedding by these agents (steam, sulphur dioxid and formaldehyd), calls for special apparatus and the super-

vision of an expert in the practical use of such apparatus. Formaldehyd gas is irritating to the mucous membrane of the eyes and nose, but it is not poisonous. It is produced either by the application of heat to an aqueous solution of the gas (formalin), or by the oxidation of wood alcohol, or by the volatization (by heat) of paraform. Various forms of apparatus have been devised for generating the gas. In the army the large "Formal Gas Generator" (No. 2) of the Kny-Scherrer Co., and the smaller apparatus manufactured by Chas. Lentz & Sons of Philadelphia, have been used with success.

5. *Chloride of Lime* (chlorinated lime, bleaching powder). This is one of the cheapest and most efficient of disinfectants. It should be packed in air-tight and moisture-proof receptacles,—glass is preferable,—and should contain at least 25 per cent. of available chlorine. It should be used in solution, which had better be made as required. An insoluble residue will be left, which may be removed by filtration or decantation. This, however, is not at all necessary. Chlorinated lime owes its disinfecting power to the presence of the hypo-chlorite of lime, a salt which is freely soluble in water, and which is quickly decomposed by contact with organic matter. Germs of all kinds, including the most resistant spores, are destroyed by this solution, but it must be remembered that the disinfectant itself is quickly decomposed and destroyed by contact with organic matter, and that if this is present in excess, disinfection may not be accomplished, especially when the germs are embedded in masses of material which are left after the hypo-chlorite of lime has all been exhausted in the solution.

6. *Mercuric Chloride* (bichloride of mercury, corrosive sublimate). This salt is well known as a deadly poison, which has long been used in domestic practice as a "bug poison." It has germicide powers of the first order, and it is consequently a disinfectant which may be recommended for certain purposes, due regard being had to its poisonous nature, and to the fact that it is decomposed by contact with lead, tin, or copper, and that lead pipes are soon rendered brittle and worthless by passing through them solutions of mercuric chloride. Its potency in dilute solutions (1 : 500 to 1 : 4000) makes it comparatively cheap,[1] and the danger of accidental poisoning from such dilute solutions is not very great. The concentrated solutions should be colored, as a precaution against accident, for they have neither color nor odor to reveal their deadly nature.

A standard solution which contains four ounces to the gallon of water is of convenient strength for a concentrated solution, to be issued by manufacturers or health authorities, in properly labelled bottles.

[1] It cost about 50 cents a pound by the quantity.

This may be colored with permanganate of potash,[1] or with indigo, or with aniline blue.

It must be remembered, in using this and other disinfecting solutions, that the condition relating to time of exposure to the action of the disinfecting agent is an important one. The experimental evidence relating to the germicide power of mercuric chloride shows that the time of exposure being two hours, this salt may be safely recommended for the destruction of pathogenic organisms in the absence of spores in the proportion of 1 : 2000, or even less, *provided that the micro-organisms to be destroyed are fairly exposed to its action.* The fact that mercuric chloride combines with and coagulates albuminous material, interferes to some extent with its value as a disinfectant, and will be kept in view in the recommendations to be made hereafter relating to the practical use of this agent. Mercuric chloride is an efficient antiseptic in the proportion of 1 : 15,000, and it exercises a restraining influence upon the development of the spores of the anthrax bacillus, when present in culture solutions, in the proportion of 1 : 300,000, and even less.

7. *Carbolic Acid.* The disinfecting power of carbolic acid has been fixed by experiments upon vaccine virus, and upon various pathogenic organisms. A saturated aqueous solution cannot, however, be relied upon for the destruction of spores; but in the absence of spores it is fatal to micro-organisms in the proportion of two per cent., the time of exposure being two hours. Indeed, less than one per cent. is fatal to several of the species of pathogenic micrococci which have served as test-organisms in the numerous experiments which have been made with this agent. Upon the recommendation of the famous Dr. Koch, the discoverer of the cholera spirillum, the committee on disinfectants, of the International Sanitary Conference of Rome (1885), has given this agent the first place for disinfecting soiled clothing, excreta, etc., in cholera. For excreta it is to be used in five per cent. solution, and for clothing, etc., in two per cent. solution. The experimental evidence upon record indicates that it may be relied upon in this proportion.

8. *Caustic Lime* (*"Quicklime"*). All of the caustic alkalies have decided germicidal value, but quicklime is the cheapest and most generally useful. For the disinfection of excreta, in the sick room or in sinks, privy-vaults, etc., freshly prepared "milk of lime" should be used, containing about one part, by weight, of hydrate of lime to eight parts of water. This should be used freely,—in quantity equal in amount to the material to be disinfected. The white-washing of ex-

[1] Ten grains to the gallon is sufficient.

posed surfaces is a satisfactory method of destroying any disease germs which may have lodged upon such surfaces.

9. Dry Heat. Dry heat is only to be recommended for the disinfection of such articles as would be injured by exposure to moist heat, or to a disinfecting solution. A properly constructed disinfection chamber or "oven" is absolutely essential, if dry heat is to be used. The experimental evidence on record shows that the destruction of spores requires a temperature which would injure woolen fabrics (140° C. for three hours). In the absence of spores, however, articles which are freely exposed for two hours to a temperature of 110° C. (230° Fahr.) may with safety be considered disinfected. In practice it will be necessary to remember that the penetrating power of dry heat is very slight, and that packages, bundles, or even articles loosely thrown one upon another, cannot be disinfected in this way.

10. Sulphur Dioxid (sulphurous acid gas). Fumigation with burning sulphur has long been a favorite method of disinfection. The experience of sanitarians is in favor of its use in yellow fever, smallpox, scarlet fever, diphtheria, and other diseases in which there is reason to believe that the infectious material does not contain spores. The experimental evidence on record shows that under certain conditions it is effective for the destruction of micro-organisms in the absence of spores, but that it is quite impotent for the destruction of these reproductice elements.

The presence of moisture adds greatly to the disinfecting power of this agent. It is freely soluble in water, one volume dissolving fifty volumes of the gas. It is therefore evident that a saturated aqueous solution is fifty times as strong as the pure gas—anhydrous. In aqueous solution, in the proportion of 1 : 2000 by weight, sulphur dioxide kills micrococci in two hours' time. In gas-tight receptacle it destroys the infecting power of vaccine virus dried upon ivory points, when present in the proportion of one volume per cent., the time of exposure being six hours. The same proportion destroys anthrax bacilli, without spores, from the spleen of an animal recently dead, dried upon silk threads, in thirty minutes (Koch). These facts show that sulphur dioxid is a valuable disinfectant; but the conditions of successful disinfection, as established by the experimental evidence, are, that the material to be disinfected shall be freely exposed to its action for a considerable time, *in a receptacle which does not permit the gas to escape.* It must be remembered that disinfection of a thin layer of vaccine virus upon an ivory point, or of anthrax blood upon a silk thread, exposed in a gas-tight receptacle, cannot be taken as evidence that thicker layers of infectious material, attached to the surface of bedding and clothing, or enclosed in folded blankets, bundles of clothing, mat-

tresses, etc., can be disinfected by the same amount of sulphur dioxid generated in a room which is not gas-tight. It has been shown, by carefully conducted experiments, that the escape of sulphurous acid gas from a bed-chamber or hospital ward is very rapid, in spite of the usual precautions for stopping up crevices when such a room is to be fumigated; and infectious material, enclosed in bundles or protected by folds of blankets, etc., may escape disinfection, after having been exposed for many hours in a tightly closed chamber containing ten volumes per cent. of this gas.

11. Copper Sulphate. This salt has been largely used as a disinfectant in France, and experiments show that in the proportion of one per cent. it is a reliable agent for the destruction of micro-organisms, in the absence of spores. It is much below mercuric chloride in germicide power, but is a better deodorant—not a better antiseptic—than the more poisonous salt. When we take into account its efficiency, it is comparatively cheap, and is to be recommended for certain purposes.

12. Zinc Chlorid. Solutions of chloride of zinc are largely used in this country and in Europe for disinfecting purposes. It is an excellent antiseptic and deodorant, but its power to destroy disease germs has been very much overestimated. It may, however, be relied upon for the destruction of pathogenic organisms, in the absence of spores, in solutions which contain from five to ten per cent. of the salt.

GENERAL DIRECTIONS FOR DISINFECTION.

In the sick-room we have disease germs at an advantage, for we know where to find them, as well as how to kill them. Having this knowledge, not to apply it would be criminal negligence, for our efforts to restrict the extension of infectious diseases must depend largely upon the proper use of disinfectants in the sick-room.

Disinfection of Excreta, etc. The dejections of patients suffering from an infectious disease should be disinfected before they are thrown into a water-closet or privy vault. This is especially important in cholera, typhoid fever, yellow fever, and other diseases in which there is evidence that the infectious agent is capable of self-multiplication, in suitable pabulum, external to the human body. Vomited matters, and the sputa of patients, with these and other infectious diseases, should also be promptly disinfected. This is especially important in cholera, diphtheria, scarlet fever, whooping-cough, and tuberculosis. It is advisable, also, to treat the urine of patients sick with an infectious disease with a disinfecting solution.

For the disinfection of excreta, etc., in the sick-room, a solution of chloride of lime is to be recommended. This is an excellent and prompt deodorant, as well as a disinfectant. A quart of the standard

solution (No. 1), recommended by the committee on disinfectants, of the American Public Health Association, will suffice for an ordinary liquid discharge in cholera or typhoid fever; but for a copious discharge it will be prudent to use twice this quantity, and for solid fecal matter a stronger solution will be required. As chloride of lime is quite cheap, it will be best to keep on the safe side, and to make the solution for the disinfection of excreta by dissolving eight ounces of chloride of lime in a gallon of water. This solution should be placed in the vessel before it receives the discharge. The material to be disinfected should be well mixed with the disinfecting solution by agitating the vessel, and from thirty minutes to an hour should be allowed for the action of the disinfectant, before the contents are thrown into a water-closet or privy vault.

For the disinfection of liquid discharges in cholera, typhoid fever, dysentery, etc., a five per cent. solution of *carbolic acid* may be used. This was recommended by the committee on disinfectants of the International Sanitary Conference, which met in the city of Rome in 1885, of which committee the distinguished bacteriologist, Prof. Robert Koch, was chairman and the present writer a member. The solution should be used in an amount at least equal to the material to be disinfected—better twice this amount. The time necessary to insure disinfection was fixed by the committee at four hours.

Milk of lime, made by slaking fresh quicklime with water and mixing the resulting hydrate of lime with eight parts of water, is one of the best and cheapest agents for the disinfection of excreta in the sick-room, on the surface of the ground, in open sinks, etc. This milk of lime should be used in an amount at least equal to the quantity of material requiring disinfection.

Chloride of zinc in ten per cent. solution may be used to disinfect the dejections of those sick with cholera or typhoid fever, or *sulphate of copper* in a solution of the same strength (ten per cent.), the amount of solution used being equal to the amount of material to be disinfected.

It will be best to burn cloths used to wipe away the discharges of the sick, and especially those used in wiping away the infectious material from the mouth and nostrils of patients with diphtheria or scarlet fever. Bits of old muslin may be used for this purpose, and should at once be thrown upon an open fire or gas stove aranged in the fire-place for this purpose.

Infected sputum may be discharged directly into a cup half full of the solution of chloride of lime recommended for excreta, or of Labarraque's solution.

Handkerchiefs, napkins, and towels used in wiping away infectious discharges, if worth preserving, should be at once immersed in one of the following solutions: Chloride of lime, 2 per cent.; carbolic acid, 2 per cent.; mercuric chloride, 0.1 per cent. (=1 : 1000).

Cloths used for washing the general surface of the body should also be disinfected with one of the above mentioned solutions; and attendants should invariably disinfect their hands by washing them in one of these solutions, when they have been soiled by the discharges of the sick.

Disinfection of the Person. Labarraque's solution, diluted with twenty parts of water, is a suitable disinfecting solution for bathing the entire surface of the body of the sick, of convalescents, or of those whose duties take them into the sick-room; or a 2 per cent. solution of carbolic acid, may be used, or a solution of mercuric chloride (corrosive sublimate) of 1 : 1000. The poisonous nature of this solution must be kept in mind.

The International Sanitary Conference of Rome gives the following directions with reference to the disinfection of the body after death from cholera:

"The body should be enveloped in a sheet saturated with one of the strong disinfecting solutions,[1] without previous washing, and should at once be placed in a coffin."

We see no objection to washing the body, if the strong solution of chloride of lime is used for this purpose. Washing with water would necessitate the careful disinfection of the water and cloths used for this purpose, and of the hands of the attendants. As the odor of chlorine or of carbolic acid would be objectionable under certain circumstances, we see no good reason for insisting upon the use of these agents, rather than on the odorless solution of mercuric chloride, which, in the proportion of 1 : 1000, would no doubt be equally effective. But when there is an odor of decomposition to be neutralized, the solution of chloride of lime will have a decided advantage on account of its deodorizing properties.

Disinfection of Clothing and Bedding. The cheapest and best way of disinfecting clothing and bedding, which is not injured by the ordinary operations of the laundry, is to immerse it in boiling water for half an hour or longer. It should be placed in boiling water as soon as removed from the person or the bed of the sick, and if it is necessary to remove the articles from the room in order to accomplish this, they should be wrapped in a sheet or towel thoroughly saturated with a disinfecting solution. If it is impracticable to disinfect such infected clothing and bedding *immediately* by boiling, it will be necessary to im-

1 Chloride of lime, 4 per cent., or carbolic acid 5 per cent.

merse it in one of the following disinfecting solutions, in which it should be left for four hours: Mercuric chloride, 1 : 2000; or the "blue solution,"[1] of this salt and sulphate of copper, diluted by adding two fluid ounces of the concentrated solution to a gallon of water; or a 2 per cent. solution of carbolic acid. The solution of chlorinated lime (2 per cent.) may also be used, but we give the precedence to the first mentioned solutions, because of the bleaching properties of this solution. The blue solution does not injure clothing, and is to be preferred for domestic use to a simple solution of corrosive sublimate, which in the concentrated form is highly poisonous, and without odor or color. When diluted as directed, this solution may, however, be used without great danger. The metallic taste of the diluted solution could scarcely fail to prevent a fatal dose from being swallowed accidentally.

Woolen garments and other articles which would be seriously injured by immersion in boiling water, or in one of the disinfecting solutions above mentioned, should be disinfected, in a properly constructed disinfection chamber, by steam or by formaldehyd gas.

Exposure to steam at 100° C. (212° Fahr.) for half an hour would be equivalent to exposure in boiling water for the same time, if the clothing is hung up in such a manner as to be fairly brought under the action of the disinfecting agent. To be certain that the steam does not fall below this temperature in the disinfection chamber, a thermometer must be placed in a corner of the room, at a distance from the point of entrance of the steam, or in an aperture from which the steam escapes. This should mark at least 100° C. for half an hour before the disinfection can be considered complete.[2] To accomplish this, it is evident that the steam must come from the generator at a higher temperature, or, in other words, must be under pressure.

It must be remembered that in a majority of the infectious diseases in which disinfection is most frequently required the specific germ does not form resistant spores (cholera, typhoid fever, tuberculosis, diphtheria, erysipelas, pneumonia, yellow fever, smallpox). In these diseases therefore it would be a mistake to forbid the use of carbolic acid, sulphur dioxid, and other agents which enjoy the confidence of sanitarians, and which have been proved by laboratory experiments to destroy pathogenic organisms in the absence of spores.

As disinfection by steam injures certain articles, *dry heat* may be used as a substitute for moist heat, but in this case a temperature of at least 110° C. (230° Fahr.), maintained for two hours, will be required.

[1] Bichloride of mercury ..... 4 oz.
Sulphate of Copper ..... 1 lb.
Water ..... 1 gal.

[2] The committee on disinfectants of the International Sanitary Conference of Rome fixes one hour as the time during which steam should be made to pass over articles to be disinfected.

In the use of dry heat, even greater care is necessary that the articles to be disinfected are freely exposed,—that is, not placed in the oven in bundles, or piled one upon another, but freely suspended in the disinfecting chamber. For it has been shown by carefully conducted experiments that the penetrating power of dry heat is very slight. A properly constructed disinfection oven, such as that of Ransom,[1] will be required if dry heat is to be used. But it will, as a rule, be preferable to disinfect such articles in a steam disinfecting chamber of modern construction in which provision is made for exhausting the air before steam under high pressure is admitted, and in which after disinfection the clothing is rapidly dried before being removed from the steam chamber.

Sulphur dioxid is a less reliable disinfectant than steam or dry heat, but when the necessary conditions are observed there is no doubt of its utility; and the fact that it does not kill the spores of anthrax and of other bacilli is no reason for rejecting an agent which has been demonstrated by experience to be one of great value, which has been proved by laboratory experiments to be fatal to pathogenic organisms in the absence of spores, and to destroy the infecting power of vaccine virus. But in using this agent the conditions of successful disinfection, which have been established by experiment, should be borne in mind. The room which is to serve as a disinfecting chamber must be very thoroughly closed: every crevice and key-hole should be carefully closed by fastening paper over it. Even this precaution will not prevent the rapid escape of gas from cracks around doors, windows, etc. It is therefore desirable, when practicable, to use a disinfecting chamber which can be hermetically closed. The articles to be disinfected must be very freely exposed, and should never be thrown into the room in bundles, or piled one upon another. We concur in the recommendations of the committee on disinfectants of the American Public Health Association, as to the amount of sulphur which should be burned, and the method of effecting its complete combustion:

"To secure any result of value, it will be necessary to close the apartment to be disinfected as completely as possible, by stopping all apertures through which gas might escape, and to burn at least three pounds of sulphur for each thousand cubic feet of air-space in the room. To secure complete combustion of the sulphur, it should be placed, in powder or in small fragments, in a shallow iron pan, which should be set upon a couple of bricks in a tub partly filled with water,

1 *British Medical Journal*, Sept. 6, 1885, p. 274.

to guard against fire. The sulphur should be thoroughly moistened with alcohol before igniting it."[1]

Since the above was written with reference to disinfection by sulphur dioxid (SO_2) the valuable germicidal properties of *formaldehyd gas* have been demonstrated, and satisfactory methods of generating this gas for purposes of disinfection have been devised. Owing to its superior germicidal value and non-toxic properties it has to a considerable extent taken the place of sulphur dioxid as a gaseous disinfectant. In making practical use of this agent a suitable apparatus will be required. For the disinfection of a room with its contents, freely exposed for surface disinfection, one pound of formalin should be volatilized for each thousand cubic feet of air-space—the time of exposure to the disinfecting action of the gas being not less than twelve hours. When paraform is used the amount required will be 60 grams to 1,000 cubic feet (Novy). In the absence of any apparatus satisfactory results have been obtained by the Department of Health of city of Chicago, as follows:

"Ordinary bed sheets were employed to secure an adequate evaporatory surface, and these, suspended in the room, were simply sprayed with a 40 per cent. solution of formalin through a common watering pot rose-head. A sheet of the usual size and quality will carry from 150 to 180 cc. of the solution without dripping, and this quantity has been found sufficient for the disinfection of 1,000 cubic feet of space. Of course, the sheets may be modified to any necessary number. * * * Surface disinfection was thorough, while a much greater degree of penetration was shown that that secured by any other method."

Formalin may also be used in the disinfection of rooms and their contents by spraying all exposed surfaces.

Experiments made by Kinyoun and others show that formaldehyd gas does not injure the color or textile strength of fabrics of wool, silk, cotton or linen and that it has no injurious action upon furs, leather, copper, brass, nickel, zinc, polished steel or gilt work. Iron and unpolished steel are attacked by the gas.

We would remark, that in the absence of suitable appliances for disinfection, and in general when the disinfected articles are of little value, consumption by fire furnishes the readiest and safest method of disposing of such articles.

For articles of value, such as upholstered furniture, etc., which would be injured by any of the processes heretofore recommended, free exposure to the air (æration) for three or four weeks is directed by the Committee on Disinfectants of the International Sanitary Conference of Rome. The same committee directs that "objects made

[1] Preliminary report, l. c., p. 427.

of leather, such as trunks, boots, etc., should be destroyed or washed several times with one of the weak disinfection solutions,"—carbolic acid 2 per cent., or chloride of lime 1 per cent.

The means heretofore recommended for the disinfection of woolen clothing, blankets and similar articles will not be sufficient for soiled mattresses. As a rule, they should be opened, and the contents disinfected by steam, with subsequent free æration, and the cover should be washed in boiling water after treatment with a disinfecting solution.

Finally, the valuable germicidal properties of direct sunlight have been demonstrated by numerous carefully conducted experiments and the time-honored domestic practice of hanging infected clothing and bedding in the "open air" is to be recommended. This should supplement disinfection by formaldehyd or sulphur dioxid.

Disinfection of the Sick-Room. Every effort should be made to prevent a room occupied by patients sick with an infectious disease from becoming infected. Carpets, stuffed furniture, curtains and other articles difficult to disinfect, should be removed at the outset. Indeed, nothing should be left in the room which is not absolutely required, and all furniture and utensils should be of such a character that they can be readily disinfected by washing with boiling water or with a disinfecting solution. Abundant ventilation and scrupulous cleanliness should be maintained, and a disinfecting solution should always be at hand for washing the floor, or articles in use, the moment they are soiled by infectious discharges. For this purpose a solution of chloride of lime may be used (4 per cent.).

It is impracticable to destroy infectious material in an *occupied* apartment by means of gases or volatile disinfectants, for to be effective these must be used in a degree of concentration which would make the atmosphere of a room quite irrespirable. These agents are therefore useful only as deodorants. They are all more or less offensive to the sick, and will seldom be required, even as deodorants, when proper attention is paid to cleanliness and ventilation.

Daily wiping of all surfaces—floors, walls, and furniture—with a cloth wet with a disinfecting solution, is to be recommended. For this purpose a solution of chloride of lime (2 per cent.), or of carbolic acid (2 per cent.), or mercuric chloride (1 : 1000), may be used.

By such precautions as have been indicated, the infection of the sick-room may be prevented, especially in those diseases, such as cholera and typhoid fever, in which the infectious agent is not given off in the breath, or from the general surface of the body, of the sick person. In smallpox and in scarlet fever there is greater danger that the infectious agent may remain attached to the surfaces in the room; for the atmosphere becomes infected from particles given off from the surface of the patient's body.

As already stated, the atmosphere cannot be disinfected while the room is occupied. There is much less reason for disinfecting it when the patient has been removed, and it is much simpler to renew it by throwing open the doors and windows than to attempt to disinfect it. Indeed, there will be no infectious particles to destroy, except such as are dislodged from surfaces, window ledges, etc., where they have settled as dust while the room was occupied; and if the precautions above recommended have been taken, the danger of such reinfection of the atmosphere will be reduced to a minimum.

Disinfection of the vacated room, then, consists in the destruction of all infectious particles which remain attached to surfaces, or lodged in crevices, in interstices of textile fabrics, etc. The object in view may be accomplished by thorough washing with one of the disinfecting solutions heretofore recommended; but most sanitarians think it advisable to "disinfect the room" with a gaseous disinfectant, such as formaldehyd or sulphur dioxid. If the "fumigation" with sulphur dioxid is resorted to, the directions given by the Committee on Disinfectants of the American Public Health Association should be followed, i. e., three pounds of sulphur should be burned for every 1,000 cubic feet of air-space. But, as already stated, disinfection with formaldehyd gas is to be preferred (see page 634).

At the end of from twelve to twenty-four hours, doors and windows should be opened, and the room freely ventilated. After this fumigation, all surfaces should be washed with a disinfecting solution (chloride of lime 2 per cent., carbolic acid 2 per cent., or mercuric chlorid 1:1000), and afterwards thoroughly scrubbed with soap and hot water. Plastered walls should be white-washed.

Disinfection of Privy Vaults, Cesspools, etc. The contents of privy vaults and cesspools should never be allowed to accumulate unduly, or to become offensive. By frequent removal, and by the liberal use of antiseptics, such necessary receptacles of filth should be kept in a sanitary condition. The absorbent deodorants, such as dry earth or pounded charcoal,—or the chemical deodorants and antiseptics, such as chloride of zinc, sulphate of iron, etc.,—will, under ordinary circumstances, prevent such places from becoming offensive. Disinfection will only be required when it is known, or suspected, that infectious material, such as the dejections of patients with cholera, yellow fever, or typhoid fever, has been thrown into the receptacles.

In the Manual for the Medical Department of the U. S. Army the following directions are given:

92. When accumulations of organic material undergoing decomposition cannot be removed or buried, they may be treated with an antiseptic solution, or with freshly burned quicklime. Quicklime is also a

valuable disinfectant, and may be substituted for the more expensive chlorid of lime for disinfection of typhoid and cholera excreta, etc. For this purpose freshly prepared *mllk of lime* should be used, containing about 1 part, by weight, of hydrate of lime, to 8 of water.

93. During the prevalence of an epidemic, or when there is reason to believe that infectious material has been introduced from any source, latrines and cesspools may be treated with milk of lime, in the proportion of 5 parts to 100 parts of the contents of the vault, and the daily addition of 10 parts for 100 parts of daily increment of feces.

Hospitals. The directions already given in regard to disinfection of the sick-room and its contents apply as well to hospital wards in which patients with infectious diseases are treated. In addition to this, it will be necessary in hospitals to guard against such infectious diseases as erysipelas, septicæmia, puerperal fever, and hopital gangrene. The antiseptic treatment of wounds, in connection with a proper regard for cleanliness and ventilation, has practically banished these diseases from well regulated hospitals. Of the first importance in effecting this are the precautions now taken with reference to the disinfection of sponges, instruments, the hands of attendants, etc.

Instruments of silver, such as probes and catheters, may be disinfected by passing them through the flame of an alcohol lamp. Instruments of steel, gum catheters, etc., may be disinfected by immersion in a five per cent. solution of carbolic acid, or in a 1:1000 solution of mercuric chloride. For instruments and vessels of copper, brass, and tin, boiling water, or the carbolic acid solution, may be used. Vessels of porcelain or glass may be disinfected by heat, or by either of the disinfecting solutions mentioned. Sponges should be kept permanently in one of the disinfecting solutions, or, what is better, may be dispensed with entirely for the cleansing of wounds. In place of them, irrigation with a disinfectant solution may be resorted to, or the discharges may be wiped away with some cheap absorbent material which can be burned after having been once used.

Patients in hospitals, with infectious diseases,, will of course be kept in isolated wards. Everything which comes from such a ward should be disinfected, and the immediate attendants of the sick should not be allowed to visit other parts of the hospital without first changing their outer clothing for a recently disinfected suit, and washing their hands in a disinfecting solution. When relieved from duty their underclothing should also be disinfected; and they should take a complete bath with one of the weak disinfecting solutions heretofore recommended.

Disinfection of Water and Articles of Food. The disinfection of drinking-water on a large scale, in reservoirs, wells, etc., is impractica-

ble. But it is a very simple matter to disinfect water which is suspected of being contaminated with the germs of cholera, typhoid fever, or any other disease transmissable in this way. This is readily accomplished by boiling. As already stated, all known disease germs are destroyed by the boiling temperature maintained for half an hour. The importance of this precaution during the prevalence of an epidemic of cholera or of typhoid fever cannot be over-estimated, when the water used for drinking purposes comes from an impure source, or is liable to contamination by discharges of patients suffering from these diseases. Those articles of food, and especially milk, animal broths, etc., which might serve as pabulum for disease germs, should, during the prevalence of an epidemic, be cooked but a short time before they are eaten. And such food, if put aside for hours after it has been prepared, should always be again subjected to a boiling temperature shortly before it is served. Food which gives evidence of commencing putrefaction is unfit for use, and in time of epidemics is especially dangerous.

Disinfection of Ships. It should be the aim of a physician attached to a passenger ship, or of the master of a vessel having no physician on board, to prevent the vessel from becoming infected when in an infected port, or when cases of infectious disease occur on board. This is to be accomplished by keeping the ship clean; by disinfecting suspected articles, and especially the soiled clothing of passengers, before they are received on board; by the isolation of cases of infectious disease which occur on board; and by the thorough execution of those measure of disinfection recommended for the sick-room. When a case of cholera or of yellow fever occurs upon a ship at sea, it cannot be taken as evidence that the vessel is infected unless at least five days have elapsed since the person attacked came on board. For he may have contracted the disease from exposure at the port of departure, or in some other locality on shore. When, however, a longer time than this has elapsed, or when several cases develop in a particular locality on ship-board, either simultaneously or successively, the vessel must be considered infected, unless it is shown that the cases are directly due to the opening of baggage containing infected clothing.

In practice, the sanitary officials at the port of arrival usually treat a vessel as infected if any case of infectious disease has occurred upon her during the voyage. This is a safe general rule, which should not be departed from unless a considerable time—five or seven days—has elapsed since the cases occurred, and they can be clearly traced to exposure before coming on board. In this case, if the ship is clean and the precautions relating to disinfection and isolation of the sick have been faithfully executed, the health officer may be justified in dis-

pensing with the general measures of disinfection which are required for an infected ship.

These measures do not differ from those heretofore recommended for the disinfection of the sick-room and its contents; but the special conditions on ship-board, and the great interests at stake, make it essential that the execution of these measures should be in the hands of sanitary experts.

In the disinfection of ships, fumigation with sulphurous acid gas has been largely practiced by those in charge of quarantine establishments. The fact that the ship may be almost hermetically closed, and the escape of gas to a great extent prevented, makes this method of disinfection more trustworthy than in the case of dwellings and hospitals. The further fact, that certain parts of the ship are inaccessible for the application of disinfecting solutions, seems to make the use of a gaseous disinfectant imperative.

Disinfection by means of steam, especially of an iron vessel, would no doubt be a difficult matter on account of the condensation which would occur from contact with the cool walls of the vessel below the water-line. But it will be well to fill the vessel with steam before introducing the sulphur dioxid; for, as already stated, the disinfecting power of this agent is much greater in presence of moisture. A well equipped quarantine establishment should have an apparatus for generating sulphurous acid gas, and injecting it into vessels, as this is the most expeditious and satisfactory method of fumigating a ship.

An essential part of the disinfection of a ship will consist in the thorough cleansing of the bilge. The International Sanitary Conference of Rome prescribed that the bilge water shall be pumped out and replaced by sea water at least twice at each disinfection of the vessel.

Merchandise. Article V, of the Report of the Committee on Disinfection of the International Sanitary Conference of Rome, says:

"V. Disinfection of merchandise and of the mails is unnecessary. (Steam under pressure is the only reliable agent for the disinfection of rags—*les chiffons en gros.*)"

We think this statement too broad, especially so far as merchandise is concerned which has been on board a ship infected with yellow fever. The poison of this disease seems to be capable of self-multiplication on a foul ship in tropical latitudes, quite independently of passengers and crew. And there is ample evidence that even when no case has occurred on an infected ship at sea, those who are engaged in discharging her cargo after arrival in port may be seized with yellow fever from breathing the infected atmosphere of the hold. Evidently merchandise conveyed on such a ship should be disinfected. But it does not seem necessary to break packages which have gone on

board in good condition, and a thorough fumigation with sulphurous acid gas will be sufficient if the unbroken packages are so distributed as to be fairly exposed to the action of the disinfecting agent. To accomplish this, and to effectually disinfect the ship, it will be necessary to discharge the cargo at the quarantine station.

The collections of the rag-man cannot properly be placed in the same category with other merchandise, such as agricultural products, hardware, new cotton or woolen goods, etc. An exception with regard to rags is indicated, but not stated with sufficient precision, in the article which we have quoted. There is evidence that smallpox has been not infrequently transmitted in rags, and sanitarians are generally agreed that it would be very imprudent to admit rags collected in or shipped from localities infected with cholera or yellow fever, without first subjecting them to thorough disinfection.

PART SECOND.

INDIVIDUAL PROPHYLAXIS AGAINST INFECTIOUS DISEASES.

The state establishes quarantine stations, to guard against the introduction of infectious diseases of exotic origin; and in enlightened countries, sanitary officials, under the direction of the central government, or of states and municipalities, are charged with the duty of guarding the public against such diseases. It is generally recognized that this is to be accomplished by the isolation of the sick, the use of disinfectants, and by general measures of sanitary police.

One way in which the individual may indirectly protect himself against such diseases is by using his influence to have this sanitary service placed in the hands of competent men, and in sustaining them in their efforts to exclude or stamp out infectious diseases by such measures as have been demonstrated by science and experience to be efficient for this purpose.

But this is not the kind of "individual prophylaxis" which we have to consider here. The question is, What can the individual do to protect himself and those immediately dependent upon him, under the various circumstances in which he may be placed, and especially in the presence of an epidemic?

As the advice we have to give will differ greatly according to the disease, we shall pass in review the principal infectious maladies of man, and shall attempt to give for each such practical instructions as will enable an intelligent person to take all practicable precautions for his own protection, and for that of his immediate family. We have first, however, to make some general remarks.

Infectious diseases are contracted by contact with the sick, through the medium of infected articles—"fomites"—or by exposure in infected localities.

The evident general rule of prophylaxis is, therefore, to avoid all of these sources of infection; but there are circumstances in which this is either impossible or unjustifiable. Duty calls the physician and the nurse into the sick-room, and no argument based upon self-protection can keep the devoted mother from the bedside of her sick child, or the wife from giving her personal attention to her husband, or the husband to his wife, when stricken by pestilence. Humanity requires that during an epidemic the sick shall be cared for, the dead buried, and the foul places cleansed. All this calls for the active and intelligent efforts of persons who have the courage to face danger, and not only of those who by their profession are necessarily brought in contact with the sick—physicians, clergymen, sanitary officials, nurses—but often, also, of volunteers; for, during the prevalence of an epidemic of cholera, or of yellow fever, the number of physicians and trained nurses within the affected area is commonly insufficient for the care of the sick.

The history of epidemics shows that brave men and women are to be found in every civilzed country, who are willing to volunteer for such perilous duties; and also that physicians, and those whose legitimate duty it is to care for the sick, very rarely desert their post in time of danger; but the mortality among these brave men and women who stand by their guns, and among the volunteers who go to their assistance, is often very great. There is a wide-spread notion among people not familiar with the facts, that doctors enjoy a certain immunity from infectious diseases not possessed by other people, and that the absence of fear is a safeguard against infection. Such a supposition is without foundation, and is an insult to the brave men and women who fall at their post of duty in every epidemic. Courage is no more a protection against disease germs than against bullets. It is true, that in epidemics, as in war, the sulkers and cowards often run into danger which the men in the ranks escape. The rashness which results from ignorance or from thoughtlessness is not courage, any more than the prudence which avoids danger when there is no good reason for facing it is cowardice. Those who rashly venture within the lines drawn by an epidemic, in the pursuit of business or pleasure, on the supposition that they will escape the prevailing disease because they are "not afraid," often fall victims to their unreasoning temerity, and not infrequently beat a hasty retreat, with blanched face, when they are brought directly into the presence of the sick and the dying.

Our advice to the brave is, Do not put your trust in your courage, for it is no armor against infection. Rely rather upon those precau-

tions which science and experience indicate as best suited to the special circumstances in which you may be placed, and do not hesitate to retreat before an invisible foe, when you are not required by considerations of duty to remain upon the field of battle. If your services are not required, you are simply in the way; and if you fall ill, you add to the labors of those who devote themselves to the care of the sick. And to the timid we would say let not your fear control your actions, but look the circumstances fairly in the face, and be guided by reason and knowledge, or by the advice of those competent to decide for you. A premature flight may bring you into ridicule, or into greater dangers than those you flee from. Do not let your fears exaggerate the facts, and weigh these in the balance of your reason, and not of your apprehensions. The fact that Judge A or Col. B has fallen a victim to cholera or yellow fever is no more reason for deserting your home than is the fact that the humblest citizen of your town has died from the same disease.

If courage is no protection against infection, it cannot be denied that fear, in the presence of the infectious agent, is a predisposing cause which frequently determines an attack, and which may turn the balance in favor of a fatal result. The depressing effect of fear is well known, and all influences which reduce the vital resisting power of the individual predispose to an attack when an epidemic is prevailing.

Other predisposing causes of a general nature are those conditions of enfeebled resistance which result from ill-health, venereal and bacchanalian excesses, etc.

Of all these, it is probable that excessive indulgence in intoxicating drinks is the most potent factor in swelling the mortality returns during the prevalence of pestilential diseases. This predisposing cause acts in several different ways. The individual whose reason is befuddled by drink, stumbles stupidly into all kinds of danger. He is "not afraid" to sleep upon the ground, exposed to the night air, when yellow fever is prevailing, or to quench his thirst with water which a prudent man would reject as unfit to drink in the presence of cholera, or to wrap himself in a blanket which has recently been in use by a patient with smallpox. Again, the debility, often attended with digestive derangement, which follows a recent debauch, constitutes a most favorable condition for the reception of the germs of cholera, of yellow fever, and of infectious diseases generally. Those who use intoxicating drinks habitually, but within the limits marked by that mental aberration or loss of reason which constitutes intoxication, are less subject to infection than the man who is suffering from the effects of a recent "spree." But if they have any organic disease of the stomach, the kidneys, or of the liver, as a result of their habits, this constitutes a

predisposition to be attacked, and is a very serious complication when an attack is developed.

Persons suffering from chronic wasting diseases, profuse discharges, or recent hemorrhage, are especially liable to become the victims of an infectious disease during its epidemic prevalence. The same is true of those whose vital resistance is below par from insufficient food, or from the continued respiration of vitiated air—crown poisoning, sewer-gas poisoning, etc.

In addition to the predisposing causes mentioned, which furnish indications of more or less value with reference to individual prophylaxis, there are individual and race differences in susceptibility to certain diseases manifested by those who are in perfect health. One man may be repeatedly exposed to an infectious disease without falling sick, while another may suffer several attacks of a disease, such as smallpox, in which one attack commonly confers immunity. Race differences in susceptibility are shown in the relative immunity of the negro from the effects of the yellow fever poison, and the great susceptibility of the same race to smallpox.

We shall consider in detail the question of individual prophylaxis against certain infectious diseases, which, by reason of their fatality and occasional wide-spread epidemic prevalence, seem entitled to special attention in an essay of this nature.

Cholera. In Asiatic cholera the danger of infection from association with the sick, in the capacity of nurse or physician, is very slight. This is amply demonstrated by experience. On the other hand, laundresses, who do not come directly in contact with the sick, but who handle clothing soiled by their discharges, are liable to contract the disease. By far the greater number of cases, however, result from exposure in infected localities, and from drinking infected water. Outside of the area in India where cholera prevails as an endemic disease, localities become infected and the water-supply contaminated as a result of the introduction of infectious material from previously infected localities, either in fomites, or through the medium of the discharges of the sick. These facts furnish the indications for individual as well as for general measures of prophylaxis.

In the sick-room the precautions to be taken are, to keep the room clean and well ventilated, to disinfect the discharges of the sick and all soiled articles as promptly as possible, and to wash the hands in a disinfecting solution when they have been in contact with the patient or with soiled clothing. Attendants should not take their food in the room occupied by the sick, and should not drink liquids which have been exposed in the sick-room.

The general directions relating to diet, drinking-water, etc., which we shall shortly give, apply to the attendants upon the sick, as well as to those at a distance from them; and it should be remembered, in the interest of the sick, that these attendants do not run any special risks beyond those to which all persons within the area of infection are exposed. Indeed, we may go further, and say that they run far less risk when they are in a well regulated hospital and under intelligent supervision, than do those persons who dwell in the localities outside of the hospital from which the cases under their charge have come.

Attendants upon the sick should have their meals at regular hours, should not be deprived of a fair allowance of sleep, and should never be allowed to become exhausted by protracted vigils or excessive fatigue.

When cholera has been introduced into a country and is extending its limits from day to day, one of the first questions which will present itself to those who are able to change their place of residence will be, whether they shall attempt to keep out of its way, and if so, where it is best to go. The answer to this question must depend very much upon circumstances. Those who are unfortunate enough to live in a city or town which has a bad sanitary record, which is not provided with an efficient health department, or does not provide money to enable the officers appointed to do efficient work, had better decamp in good time, so as to evade the foe entirely, or to meet it upon a field more favorable for defensive operations. There should be no stampede, and no running away in haste without any definite idea of why and where. The time to go is before the disease has fairly obtained a lodgment. Consider that if the season is not far advanced, and the town is in an unfavorable sanitary condition, there is every reason to anticipate that the first cases will be followed by a severe epidemic, and decide at the outset whether you will put your castle in order to stand a siege, trusting to well considered measures of individual prophylaxis, or whether you will beat a masterly retreat in advance of the first assaults of the enemy. Those who vacillate, in the hope one day that the epidemic is on the decline, and in the fear the next that it will sweep everything before it, in the end very often stay, when they could just as well have gone, and at the same time neglect those precautions which they should have taken at the outset if they had decided to stay.

To those who are unable or unwilling to desert their homes, we would say, that when proper precautions are taken the danger is really not very great, and that sanitarians look for the day when cholera will be practically banished from civilized countries. See that your premises are in good sanitary condition, and do what you can to induce your neighbors and the authorities in your town to prepare for the

storm. Look especially after the plumbing of your houses, and if there is a cesspool or privy vault upon your premises, see that it is kept in good condition by the use of antiseptics and deodorants.[1] Above all, see that no food comes into your house except such as is sound and good, and that the drinking-water used by your family is beyond suspicion. Well-water is always open to suspicion, and in general, during the prevalence of cholera, it will be advisable to *boil all water used for drinking purposes.* This is a prophylactic measure of prime importance, and there is good reason to believe that if faithfully executed it would, to a great extent, limit the ravages of the Asiatic pestilence. Tea and coffee recently made can be taken with impunity. Milk, during the prevalence of an epidemic, should be boiled before it is used as food. Mineral waters, if bottled at places distant from the infected area, may be drunk in moderation. A moderate amount of sound wine, which was bottled prior to the epidemic, may be permitted to those who are in the habit of using it. Those not in the habit of using stimulants should not resort to their use during the progress of an epidemic. Those accustomed to them should restrict their libations within moderate limits, and will find a little brandy and soda, or Apollinaris water, to be better than wines, and especially than the acid wines, which are apt to derange the digestion.

Food should be plain and well cooked, and should be taken in moderate quantities. Intemperance in eating is quite as bad as intemperance in drinking. Soups, meats and vegetables should always be served hot, and should not be put aside for a future repast, or, if served a second time, should be brought to the temperature of boiling water shortly before they are eaten. Pastry and rich puddings, and all coarse and indigestible meats and vegetables, are to be avoided. Sound, ripe fruit, which has been brought to the house with the outer skin unbroken, may be eaten in moderation by those who know by experience that it agrees with them. It should be carefully washed before it is eaten. Melons, cucumbers, unripe apples, peaches, or pears, acid fruits generally, and, in short, all those articles which are known to give rise to digestive derangements in the absence of cholera, would better be banished from the supply-list during the prevalence of this disease.

Next to the precautions relating to food and drink, we would place those relating to personal habits and clothing. The bowels should not be allowed to become constipated, and, on the other hand, any tendency to diarrhœa should at once receive attention. This is a matter of the greatest importance, and, indeed, is second to none other in individual prophylaxis. *Absolute rest,* a light diet, and a dose or two of chloro-

[1] See Part First of this Essay for details relating to the use of these agents.

dyne, or of Hope's mixture, or of any approved combination of an opiate and an astringent, will usually suffice to control a slight diarrhœa, even if it is of a choleraic character.

The clothing should be suited to the season, but great care must be taken that it is warm enough at all times to prevent the body from becoming chilled. A broad flannel belt worn about the abdomen is recommended by many physicians of experience, and is no doubt useful. Baths should be taken at frequent intervals, but should not be too prolonged or too cold, and should be followed by a vigorous rubbing of the surface, to establish reaction. Excessive exercise and fatiguing labor of all kinds are to be avoided. One should never feel "done up," as a result of his exertions in the way of business or of pleasure, for the lassitude resulting from over-exertion, like that which results from fear, predisposes to an attack. Mental depression is, so far as possible, to be avoided; grief, despondency and "carking care" are recognized as predisposing causes in cholera and in other infectious diseases.

The use of "sulphuric acid lemonade"—that is, of pure water acidulated with this acid and sweetened to taste—has been recommended as a prophylactic, and there is some evidence in favor of its usefulness. We would not advise its indiscriminate use, or that of any other prophylactic of this nature. When cholera has made its appearance in a dwelling or in a public institution, the inmates may be given this, to the exclusion of all other drinks.

Yellow Fever. This disease, like cholera, is contracted in infected localities, rather than by contact with the sick. Indeed, it is rarely, if ever, communicated directly by a sick person to his attendants. In infected places the poison seems to be given off from the soil, or from collections of decomposing organic matter, and we have no definite evidence that it is communicated through the medium of food or drinking-water. The history of epidemics of this disease shows that when it obtains a lodgment in a city or town which is in an insanitary condition, in southern latitudes and during the summer months, it extends its area and invades new localities similarly situated, until frost occurs, or at least until the weather becomes comparatively cool in the autumn. Those who remain in an infected area, unless protected by a previous attack, are almost certain to contract the disease, and much less can be done in the way of individual prophylaxis than in cholera. We therefore advise all those who can get out of the way of this fatal disease to do so. As a rule, there will be plenty of time, after there is evidence that the disease has established itself in certain parts of a city, for those who live at a little distance from these centers of infection to get away, in a deliberate and well considered manner. The occurrence of one or more imported cases cannot be taken as evidence that

an epidemic will follow, and is no reason for deserting one's home. If proper precautions are taken by the sanitary authorities, it is very probable that no evil result will follow such importation of the disease. But when these imported cases are followed by the occurrence of other cases in the vicinity where they have been sick, or when such local cases occur in the vicinity of wharves where vessels from infected ports discharge their cargoes, or in sailors' boarding-houses, etc., it must be taken as evidence that the disease has effected a lodgment, and that infected centers have been established, from which an epidemic will in all probability be developed, if the season is favorable and the city in an insanitary condition.

An epidemic is not developed so rapidly as in the case of cholera, but the disease usually extends its limits in a very deliberate way, and while it is claiming its victims in one section of a city, other sections in the immediate vicinity might be quite healthy. But the territory invaded remains infected until cold weather puts an end to the epidemic. Frequently it happens that no new cases occur in an infected area for several weeks, or even months, for the simple reason that all those who remained to do battle with the pestilence have suffered an attack or are protected by a previous attack. The epidemic has ceased for want of material, but the infection remains, and will manifest itself if unprotected persons venture within the infected area from a mistaken idea that there is no more danger because there are no longer any cases.

In this disease, then, the most important point in individual prophylaxis is to keep away from infected localities, and from those places where the disease is epidemic—*e. g.*, Havana, Veracruz, Rio Janeiro—during the season of its prevalence. Very many lives have been sacrificed by a misplaced confidence in the protection which courage is supposed to afford against this disease. "I am not afraid," says the merchant whose business calls him to an infected city, or the sea-captain who wishes to obtain a cargo of sugar in Havana during the summer months. But not being afraid does not prevent such persons from being attacked. And the mortality in Havana among sailors from northern latitudes is very great. There is a tendency in places where the disease is endemic to underrate its malignity, and to ascribe every fatal case to some fault on the part of the unfortunate victim or his attendants. He was "frightened to death," or "was not properly nursed," or he was "imprudent," etc., etc. The mortality is no doubt largely influenced by these secondary causes, but yellow fever is a malignant disease, which under the most favorable circumstances is very fatal to unacclimated strangers within the limits of its endemic prevalence, and which in its epidemic extension in new territory often claims from 30 to 35 per cent., or even more, of those who fall sick, as its victims.

This being the case, we repeat our advice to all those whose duty does not require them to stay on the field of battle, to make an orderly retreat to some place of safety.

The precautions relating to food and to personal habits do not differ materially from those recommended in the case of cholera. The diet should be simple, and excesses should be avoided. Less care will be necessary with reference to the use of fruits and vegetables—indeed, they are rather to be recommended, as better suited than animal food to the warm latitude in which this disease prevails. Constipation should, above all things, be avoided; and if there is evidence that the functions of the liver or kidneys are imperfectly performed, suitable medication should be resorted to.

There is no special danger from the use of water, if it is from a source which insures it from contamination with organic impurities. Spirituous liquors, if used at all, should be taken in great moderation. Nothing is more likely to develop an attack than alcoholic excesses, and the habitual drunkard is almost doomed to death if he falls sick with this disease. Exposure to the direct rays of the sun, excessive fatigue, and venereal excesses are all predisposing causes which it is within the province of individual prophylaxis to avoid. Exposure to the night air, and especially sleeping out of doors near the ground, is recognized by experienced physicians in yellow fever regions as an invitation to an attack. Great care should be taken to avoid chilling of the body, and it is well to sleep as far from the ground as possible. The creoles of Louisiana and of the West Indies generally insist upon closing the windows of a sleeping-room at night.

The mortality among natives of tropical climates, and especially among those whose habits are good, and who are accustomed to a frugal mode of life, is very much less than among the natives of northern latitudes, when these come, without any previous "acclimation," within the influence of the yellow fever poison. Those who are habituated to life in the extreme South enjoy a certain immunity from the effect of the poison, which is shown by a lower death-rate rather than any exemption from being attacked. One attack of this disease, as a rule, confers immunity from a subsequent attack.

Individual prophylaxis in an infected city will include the avoidance of those localities which give special evidence of being infected, and especial care not to visit such localities at night.

The liberal use of disinfectants in cesspools and water-closets, and a perfect state of sanitary police in and around the premises, will constitute a most important part of the precautionary measures which every individual should take for his own protection and that of his family. A state of mental equilibrium, and an intelligent appreciation of the

special circumstances in which he is placed, and of the various measures of prophylaxis heretofore indicated, will enable an individual to look the facts fairly in the face, and to be goverened by the light of reason and of science. Unfortunately it too often happens, among the ignorant and degraded, that a spirit of bravado, attended with a neglect of the simplest sanitary precautions, and a disposition to deny the presence of the dreaded foe, prevails during the earlier stages of an epidemic, and that this is followed by a disorderly stampede and a disgraceful neglect of the sick, when the presence and malignant nature of the pestilence are recognized.

Smallpox. This disease is contracted by exposure to emanations from the body of the sick, or from articles which have been in use by them, or exposed in their vicinity. There is no evidence that the smallpox poison multiplies external to the human body, and the indications for prophylaxis are therefore quite different from those already given for cholera and yellow fever. One may eat what he pleases, and wallow in filth, when smallpox is prevailing, without contracting the disease, so long as he keeps away from the sick, and is not brought in contact with any article infected by them. In this disease, however, as in the infectious diseases generally, previous personal habits will greatly influence the result when exposure does occur; and the disease is more fatal to the victims of alcoholism, to those who are poorly nourished, and, in general, to those whose vitality is reduced by exposure to noxious effluvia from putrefying material, by living in overcrowded and ill-ventilated apartments, etc.

As it is now the universal practice to isolate smallpox patients as soon as the disease is recognized, the danger of coming, accidentally, in contact with them is not great. There is but little danger of infection from passing within a few yards of a patient with smallpox in the open air, or from passing a building in which cases are under treatment. Unprotected persons who enter the sick-room are, however, extremely liable to contract the disease; and the infectious material given off from the patient's body clings most tenaciously to surfaces, to clothing, etc., and may give rise to an attack after many months, unless destroyed by disinfection.

It is evident, then, that individual prophylaxis will include the avoidance of places which have been occupied by the sick, and of articles used by them, unless there is a certainty that they have been thoroughly disinfected. It is probable that an unprotected person, who feels obliged, for special reasons, to enter the sick-room, may escape infection by the use of an air filter placed over the mouth and nostrils. This should be constructed on the principal of the "Tyndal respirator," in which all inspired air is made to pass through a layer of cotton wad-

ding, which arrests suspended particles. It would be necessary immediately on coming out of the room to burn the cotton filter, to bathe the hands and face in a disinfecting solution, and to change the outer clothing.

It is a general rule in regard to infectious diseases that those who are necessarily exposed to them should take the precaution of not going into the sick-room with an "empty stomach," or in a condition of exhaustion from any cause. A cup of coffee, or a glass of wine and a cracker, may be taken if a considerable interval has elapsed since the last regular meal.

It is well-known that against smallpox we have a special measure of prophylaxis, which has restricted the ravages of this disease within the limits which are left to it by carelessness in regard to the application of this measure, or ignorance of its value. Since the famous discovery by Jenner, vaccination has become the prophylactic *par excellence*.

The immunity conferred by vaccination is, as a rule, complete; but there are exceptions to this rule, and vaccinated persons occasionally suffer from a modified form of the disease. The statistics of the London smallpox hospital show that the mortality among unvaccinated persons received into that hospital with smallpox, is 35.55 per cent.; while the mortality among vaccinated persons is less than 7 per cent. No doubt a large proportion of the cases of post-vaccinal smallpox might have been prevented by revaccination.

It is now recognized that the protective influence of vaccination is not always of a permanent character, and children who have been successfully vaccinated in infancy should be revaccinated when they reach the age of puberty, or sooner, if smallpox is prevailing in the neighborhood. The operation is so trifling that it is customary to vaccinate old and young, with the exception of those who have been successfully vaccinated within a year or two, whenever an outbreak of smallpox occurs. This practice is to be recommended, but when the operation has been performed in a proper manner, with virus which is known to be reliable, it is folly to insist upon a frequent repetition of the vaccination, because "it didn't take." If the first vaccination has been completely successful, a *perfect* result from revaccination is not usually obtained; and the fact that no result is obtained must be taken as evidence that the person is protected. The prophylactic value of vaccination practiced after exposure to smallpox has been demonstrated, and one who is not entirely certain that he is protected by a recent successful vaccination will do well to resort to this important prophylactic measure at once, if he has reason to suspect that he has been exposed to smallpox.

Scarlet Fever. In this disease, as in smallpox, the poison is given off from the bodies of the sick, and is not reproduced independently of them. As we have no knowledge of any means of protection corresponding with vaccination, prophylaxis consists solely in keeping out of the reach of infection by the sick, or by articles infected by them.

The sick person may communicate the disease during the whole period of his illness and convalescence,—a period which often extends to five or six weeks, or even longer than this. Infected clothing, which has been packed away for months, may communicate the disease; and there are numerous instances on record of its transmission to children at a distance from the sick, by healthy persons who have recently come in contact with scarlet fever patients. The lower animals, and especially pet cats and dogs which may have visited the sick-room unnoticed, or which are thoughtlessly given to convalescent children for their amusement, constitute a great source of danger. Persons who have suffered an attack of the disease, or who have but little susceptibility to it, may have a slight sore throat as a result of exposure to the scarlet fever poison, and may communicate the disease in its more severe form to unprotected children. One great difficulty in arresting the progress of an epidemic by isolation of the sick and disinfection, results from the fact that these slight and often unrecognized cases are frequently allowed full liberty.

Infection has been traced to milk which had been standing in the sick-room, or to the same liquid which had become infected in a dairy where scarlet fever had prevailed, and where recent convalescents were permitted to milk the cows.

All of the facts point to a most rigid exclusion of susceptible children from every possible source of infection. The susceptibility of adults is very much less, and, when attacked, they usually have the disease in a mild form. But their responsibility extends far beyond the point of avoiding the sick for their own protection. Those who are associated with susceptible children have no right under any circumstances to visit the room of a scarlet fever patient without taking the most thorough precautions with regard to the disinfection of their person and clothing immediately upon leaving it; and even with these precautions, such a visit cannot be justified when it is made simply out of curiosity or friendship. Only those who are in attendance upon the sick should be allowed in the sick-room, and they must be regarded as infected persons, who are not to be permitted to come in contact with unprotected children while they are engaged in this duty.

Diphtheria. This is a disease in which the infectious material is given off from the surfaces affected, and not from the general surface of the body. As the usual seat of the disease is the throat and the nasal

mucous membrane, it is the discharges from these surfaces which are especially dangerous. Although adults are much less susceptible to the disease than children, there have been numerous instances in which they have contracted diphtheria by the accidental reception of a bit of infectious material directly into the fauces. This is especially liable to occur during the operation of tracheotomy; and several physicians have lost their lives in this way, in their efforts to save those of their patients by aspirating through the tracheotomy tube. It seems extremely probable that the diphtheria bacillus is capable of increase independently of the sick, in damp, foul places, such as sewers, damp cellars, and especially under old houses in which the floors come near the surface of the ground, leaving a damp, ill-ventilated space. At all events, the disease often clings to such houses in spite of the application of the usual means of disinfection. There is no doubt as to the influence of bad hygienic conditions in maintaining the infection when the disease has been introduced, and it is possble that such conditions may, in certain cases, originate it.

Insufficient nourishment, the malarial poison, and insanitary surroundings are predisposing causes to the disease. Those suffering from scarlet fever, measles, whooping-cough, and tuberculosis are also especially liable to be attacked. As in the case of scarlet fever, mild cases, which is the absence of others more pronounced it would be difficult to recognize as true diphtheria, may give rise to malignant diphtheria in more susceptible individuals, or in those whose vital resisting power is reduced by any of the causes mentioned.

Prophylaxis will demand complete non-intercourse with the sick, avoidance of infected localities, and care to exclude all persons and articles coming from such houses from contact with yourself or children. The disease is often spread by thoughtless persons who visit the sick-room, and even kiss the infected patients, and then, without any precautions in the way of disinfection, fondle healthy children in other places, and perhaps transmit by a kiss the infectious material which has adhered to their lips. The possibility of transmission by pet animals is also to be borne in mind.

It has been demonstrated by the bacteriologists connected with the health departments in our large cities that the diphtheria bacillus is often found in the throats of patients convalescent from this disease for three or four weeks after the attack, and exceptionally for a much longer time than this. The time when it will be safe for a convalescent from this disease to associate with susceptible children can therefore not be determined with certainty except by a bacteriological examination made by an expert.

The most important method of prophylaxis for children who are unavoidably exposed to the danger of infection is the use of protective inoculations by sub-cutaneous injection, of the diphtheria antitoxin. The value of this method has been amply and repeatedly demonstrated in children's hospitals, in asylums, and in private practice. The protection afforded by such inoculations is not permanent, and probably, as a rule, does not last longer than a few weeks.

Tuberculosis. Scientific researches have demonstrated that tubercular consumption is an infectious disease, and that the sputa of those affected with it, injected into susceptible animals, reproduces in them the same disease. This sputum is therefore infectious material, and should be destroyed by burning, or by the use of chemical disinfectants. There would be little danger of infection from the moist masses of sputum, but in a desiccated condition this material is liable to reach the lungs of susceptible individuals, and to induce the disease.

It is well known that there is a great difference in susceptibility to pulmonary consumption, and that in certain families this disease carries off one member after another, while it is unknown in other families. Those who have this hereditary predisposition should pay special attention to individual prophylaxis. They should avoid intimate association with consumptive persons, should live under the best hygienic conditions, in dry, well-ventilated apartments, and should select an occupation which will keep them in the open air, rather than one which keeps them confined to the house. Above all, they should avoid the respiration of an atmosphere loaded with organic impurities, or with irritating inorganic particles—dust of various kinds. Out of door life on the high and dry plains in the center of the continent, or in the mountains, will in most instances enable them to overcome the predisposition, if commenced before infection and the resulting tubercular lesions have occurred.

Those who are engaged in occupations which require them to pass some hours each day in an atmosphere loaded with dust will do well to wear a respirator for filtering the suspended particles from the air; for it is demonstrated that, independently of hereditary predisposition, the respiration of such an atmosphere predisposes to tubercular disease of the lungs.

Typhoid Fever. In this disease, as in cholera, the infectious agent is contained in the alvine discharges of the sick. In the interest of self-preservation as well as in that of the public good, every individual who has charge of cases should see that the evacuations from the bowels are thoroughly disinfected before they are thrown out.

The drinking of water contaminated with such infectious discharges is recognized as a very frequent mode of infection; and individual prophylaxis demands an intelligent consideration of the source from which

a supply of drinking-water is obtained for personal or family use. If there is the least reason to suspect that this supply may be contaminated by typhoid material, or if it contains an undue amount of organic impurities, it should be rejected entirely, or boiled shortly before it is used.

Typhoid epidemics have in several instances been traced to using milk which had been contaminated by infected water, added to it directly, or used at the dairy for washing the vessels containing it. The remedy in this case is to verify the purity of the source of supply of all milk used for drinking, or to boil it immediately before it is used.

The water of wells located within the limits of a city or village should not, as a rule, be used for drinking purposes, for the soil is almost certain to be polluted; and it often occurs that the contents of privy vaults and cesspools pass into the same porous stratum of sand or gravel from which the well-water is obtained, or that surface drainage finds its way into shallow wells. It will be necessary, also, to regard with suspicion the water of small streams and ponds which are so situated that they may receive the drainage from collections of filth upon their margin.

Next to impure water we must place impure air as a factor in the etiology of typhoid fever. There is good reason to believe that the germs of the disease may be carried by the foul gases which are given off from sewers, privies, etc., when these become infected, and that the disease may be induced by the respiration of such a contaminated atmosphere. At all events, the breathing of a vitiated atmosphere, and insaintary surroundings generally, constitute predisposing causes which should be avoided.

There can be no doubt that typhoid fever, cholera, and other infectious diseases are not infrequently transmitted through the agency of insects, and especially of flies. These domestic pests are likely to light upon the excreta of persons suffering from infectious diseases, if it is left standing in receptacles of any kind, or is thrown without previous disinfection upon the ground or in shallow pits. From these foul places, with their feet and legs soiled by contact with material containing typhoid or cholera germs, they may fly to a neighboring kitchen and there light upon articles about to be served as food, or may fall into the milk jug, etc. This mode of infection is to be prevented by cleanliness, prompt disinfection of all infectious material and the use of suitable screens to exclude these carriers of infection from human habitations.

In typhoid fever, as in yellow fever and cholera, depressing mental emotions, such as grief, despondency, or fear, and physical exhaustion from excessive fatigue, insufficient food, etc., are predisposing causes which may induce an attack in the presence of the infectious agent.

Malarial Fevers. One of the latest and most important achievements of scientific medicine is the demonstration that malarial fevers are due to infection by a microscopic parasite which is found in the blood, and that the usual way in which such fevers are contracted is by the stings of infected mosquitoes. Fortunately not all mosquitoes are infected with this parasite. A certain species, found in marshy regions in tropical or sub-tropical countries, has been proved to be chiefly concerned in the transmission of these fevers to man. The evident measures of prophylaxis consists in avoiding the marshy regions where these noxious insects abound, and especially at night, when they are most active; or in the use of mosquito bars and other means of protection from the stings of these infected mosquitoes when in the vicinity of the places infected by them.

In addition to these precautions it is best to take from five to ten grains of quinine daily as an antidote to infection, when exposed in a decided malarious region. In giving these directions it must be remembered that they refer only to the typical malarial fevers which are contracted in marshy regions. The so-called "malaria" of cities is, as a rule, due to entirely different causes.

Concluding remarks. This chapter might be greatly extended, but, having passed in review the principal measures of individual prophylaxis against those infectious diseases which are most fatal, we shall not dwell upon precautions to be taken in other contagious diseases, such as measles and whooping-cough. These precautions will not differ from those already recommended in the cases of smallpox and scarlet fever. So, too, in regard to the infectious skin diseases. These are communicated by personal contact, and rarely occur except among those who neglect personal cleanliness, as well as other sanitary laws. Soap and water will generally suffice for individual prophylaxis. By avoiding filthy persons as well as filthy places, the danger of contracting these and certain other unmentionable infectious diseases will be reduced to a minimum.

CONSTITUTION

OF THE

AMERICAN PUBLIC HEALTH ASSOCIATION.

TITLE.

I. This Association shall be called "THE AMERICAN PUBLIC HEALTH ASSOCIATION."

OBJECTS.

II. The objects of this Association shall be the advancement of sanitary science, and the promotion of organizations and the measures for the practical application of public hygiene.

MEMBERS.

III. The members of this Association shall be known as Active and Associate. The Executive Committee shall determine for which class a candidate shall be proposed. The *Active* members shall constitute the permanent body of the Association, subject to the provisions of the constitution as to continuance in membership. They shall be selected with special reference to their acknowledged interest in, or devotion to, sanitary studies and allied science, and to the practical application of the same. The *Associate* members shall be elected with special reference to their general interest only in sanitary science, and shall have all the privileges and publications of the Association, but shall not be entitled to vote.

Delegates from national, state, provincial, and municipal boards of health, organized sanitary associations, and the army, navy, and marine hospital service, shall be entitled to be enrolled as active members upon presentation of their credentials to the Executive Committee. Members, not delegates from such bodies, shall be elected as follows:

Each candidate for admission shall first be proposed to the Executive Committee, in writing (which may be done at any time), with a statement of the business or profession and special qualifications of the person so proposed. On recommendation of a majority of the committee, and on receiving a vote of two-thirds of the members present at the regular meeting, the candidate shall be declared duly elected a member of the Association. The annual fee of membership in either class shall be five dollars.

OFFICERS.

IV. The officers shall be a President, a First and a Second Vice-President, a Secretary, and a Treasurer.

All the officers shall be elected by ballot, annually, except the Secretary, who shall be elected for a term of three years.

PRESIDING OFFICER.

V. The President, or in his absence one of the Vice-Presidents, or in their absence, a chairman *pro tempore*, shall preside at all meetings of the Association. He shall preserve order, and shall decide all questions of order, subject to appeal to the Association. He shall also appoint all committees authorized by the Association, unless otherwise specially ordered.

SECRETARY.

VI. The Secretary shall have charge of the correspondence and records of the Association; and he shall also perform the duties of Librarian. He, together with the presiding officer, shall certify all acts of the Association. He shall, under the direction of the Executive Committee, give due notice of the time and place of all meetings of the Association, and attend the same. He shall keep fair and accurate records of all the proceedings and orders of the Association; and shall give notice to the several officers, and to the Executive and other committees, of all votes, orders, resolves, and proceedings of the Association, affecting them or appertaining to their respective duties.

TREASURER.

VII. The Treasurer shall collect and take charge of the funds and securities of the Association. Out of these funds he shall pay such sums only as may be ordered by the Association, or by the Executive Committee. He shall keep a true account of his receipts and payments, and at each annual meeting render the same to the Association, when a committee shall be appointed to audit his accounts. If, from the annual report of the Treasurer, there shall appear to be a balance against the treasury, no appropriation of money shall be made for any object but the necessary current expenses of the Association, until such balance shall be paid.

STANDING COMMITTEES.

VIII. There shall be the following standing committees: (1) The Executive Committee, (2) the Advisory Council, (3) the Committee on Publication.

EXECUTIVE COMMITTEE.

IX. The Executive Committee shall consist (1) of the President, First Vice-President, Second Vice-President, Secretary, and Treasurer;

(2) of six active members, of whom three shall be elected annually by ballot, to serve two years, and who shall be ineligible to reëlection for a second successive term; and (3) of the ex-presidents of the Association.

It shall be the duty of the Executive Committee to consider and recommend plans for promoting the objects of the Association, to authorize the disbursement and expenditure of unappropriated moneys in the treasury for the payment of current expenses; to consider all applications for membership, and at regular meetings, report the names of such candidates as a majority shall approve; and, generally, to superintend the interests of the Association and execute all such duties as may, from time to time, be committed to them by the Association. At least one month preceding the annual meeting of the Association, the Executive Committee shall cause to be issued to members a notice of such meeting, and they are authorized to publish the same in medical, scientific, and other periodicals, but without expense to the Association; and such notice shall contain the order of business to be followed at said meeting, and, briefly, the subjects to be presented and the special points of discussion.

ADVISORY COUNCIL.

X. The Advisory Council shall consist of one member from each state, territory, and district, the army, navy, and marine hospital service, the Dominion of Canada, and each of the Provinces, who shall be appointed by the President on the last day of each session, and who, besides acting as nominating committee of officers for the ensuing year, to be announced at such time as the Executive Committee may appoint, shall consider such questions and make such recommendations to the Association as shall best secure the objects of the Association. They shall at their first meeting elect from their own number a Secretary, whose record of their proceedings shall be made part of the records of the Association.

COMMITTEE ON PUBLICATION.

XI. The Committee on Publication shall consist of the Secretary and two active members, selected by the Executive Committee, who shall contract for, arrange and publish, under authority of the Executive Committee, the proceedings of the Association, including such papers as have been examined and approved by the Executive Committee, or which have been submitted to them by the latter for their discretionary action.

REPORTS AND PAPERS.

XII. All committees, and all members preparing scientific reports of papers to be laid before the Association at its annual meetings, must give, in writing, the title of such reports or papers, the time to be occupied in reading them, and an abstract of their contents, to the Executive

Committee, at least one week preceding the date of such meeting, to secure their announcement in the order of business.

MEETINGS.

XIII. The time and place of each annual meeting shall be fixed at the preceding annual meeting, but may be changed by the Executive Committee for reasons that shall be specified in the announcement of the meeting. Special meetings may be called at any time or place, by concurrence of two-thirds of the Executive Committee. There shall be no election of officers, or change of By-laws, or appropriation of money to exceed the amount at that time in the treasury, at such special meeting, except by a vote of a majority of all the members of the Association. Whenever a special meeting is to be held, at least one month's notice shall, if possible, be given by circular to all the members, together with the order of business.

QUORUM.

XIV. At the annual meeting nine members shall constitute a quorum for the election of officers, a change of the constitution, the election of members, and the appropriation of moneys.

ORDER OF BUSINESS.

XV. The order of business at all meetings of the Association shall be fixed by the Executive Committee, and such order must be completed before any other business is introduced, except such order of business is suspended by a vote of four-fifths present.

ALTERATION OF CONSTITUTION.

XVI. No alteration in the constitution of the Association shall be made except at an annual meeting, or unless such alteration shall have been proposed at a previous meeting, and entered on the minutes with the name of the member proposing the same, and shall be adopted by a vote of two-thirds of the members present.

PROPOSED AMENDMENTS TO THE CONSTITUTION.

To Article IV. After the word Treasurer, add "and the officers of the various sections."

To Article IX. After the word Treasurer, add "and Chairmen of the various sections."

Add as new article the following:

Article XVII. Members of the Association may be authorized to form themselves into sections by vote of the Association at any annual meeting; such sections shall have power to nominate their officers to be elected by the Association, and to make by-laws which shall go into effect when approved by the Association.

BY-LAWS OF THE EXECUTIVE COMMITTEE.

QUORUM.

1. Five members shall constitute a quorum for the transaction of such business as may come before the committee.

MEMBERS RESTRICTED.

2. No Elective member of the Executive Committee shall be at the same time a member of the Advisory Council, if there is another member of the Association from his state or service.

PARLIAMENTARY USAGE.

3. Cushing's Law and Practice of Legislative Assemblies shall be the guide of parliamentary practice until otherwise ordered.

PAPERS.

4. All papers presented to the Association must be either printed, type-written, or in plain handwriting, and be in the hands of the Secretary at least twenty days prior to the annual meeting, to insure their critical examination as to their fulfilling the requirements of the Association.

5. If any paper is too late for critical examination, said paper may be so far passed upon by the Executive Committee as to allow its reading, but such paper shall be subject to publication or non-publication, as the Executive Committee deem expedient.

6. All papers accepted by the Association, whether read in full, by abstract, by title, or filed, shall be delivered to the Secretary as soon as thus disposed of, as the exclusive property of the Association. Any paper presented to this Association and accepted by it shall be refused publication in the transactions of the Association, if it be published, in whole or in part, by permission or assent of its author, in any manner prior to the publication of the volume of transactions, unless written consent is obtained from the Publication Committee.

7. Day papers shall be limited to twenty minutes, and evening papers to thirty minutes each.

DISCUSSION OF PAPERS.

8. After the leading papers on each subject, as indicated by the Executive Committee, have been read, discussion shall follow, and be confined strictly to the subject of these papers; and each speaker shall be

limited to ten minutes, and shall not speak a second time until after every other member who desires to be heard, and then only for five minutes, except by unanimous consent.

9. The Chair shall notify gentlemen who desire to speak to send up their names, and they shall be called on in the order sent up; and he may, at his discretion, limit the time of speaking to five instead of ten minutes, if in his judgment it may become necessary to do so in order to allow each one on the list an opportunity to be heard.

PUBLICATION COMMITTEE.

10. The Committee on Publication, charged with the duties of selecting and printing the papers and transactions of the Association, shall consist of three active members of the Association, and of whom one shall be the Secretary, appointed by the Executive Committee during the session of the Association, and selected with reference to their facilities of meeting.

11. All papers read by title, and others not definitely passed upon by the Executive Committee, shall be referred to the Publication Committee for critical examination; and said committee is authorized to reject such papers as in its judgment are not worthy of publication, and to omit such others as cannot be included within the limits of the annual volume.

12. The Publication Committee shall procure a copyright on the transactions in the name of the Association, and the committee shall have full charge of the publication of the transactions.

APPLICATION FOR MEMBERSHIP.

13. All applications for membership must be made upon the application blank of the Association.

14. Persons not members, having prepared papers to be presented at the meetings of the Association, shall be proposed for membership at the first business meeting of the Association.

EXPENDITURES.

15. All bills connected with the publication of the transactions shall, upon the approval of the chairman of the Publication Committee and the Secretary, be signed by the President of the Association, and paid by check of the Treasurer directly to the party concerned; and the President shall not approve any bill, relating either to publishing or printing, without the approval first of the chairman of the committee in charge thereof.

16. Bills for current expenses shall be first approved by the Secretary, then sent to the President, and on his approval they shall be paid by check of the Treasurer directly to the parties interested.

17. The actual and necessary traveling expenses of the Secretary and Treasurer to the annual meeting of the Association, and to one meeting of the Executive Committee, shall be classed as current expenses.

RESOLUTIONS.

18. All resolutions presented to the Association shall be sent to the Chair in writing, and referred to a committee without discussion.

ARREARAGES.

19. The arrearages of all members remitting their dues for two years shall be cancelled up to the date of the last payment, but they shall be entitled to the transactions of the Association only for the years for which they have actually paid.

AUDITING COMMITTEE.

20. An Auditing Committee shall be appointed by the Chair to audit the accounts of the Treasurer, and report upon the same.

OFFICERS AND COMMITTEES

OF THE

AMERICAN PUBLIC HEALTH ASSOCIATION.

OFFICERS, 1899-1900.

President.....Dr. Peter H. Bryce, Toronto, Ontario.
First Vice-President.....Dr. Henry M. Bracken, Minneapolis, Minn.
Second Vice-President.....Dr. Juan Breña, Zacatecas, Mexico.
Secretary.....Dr. Charles O. Probst, Columbus, O.
Treasurer.....Dr. Henry D. Holton, Brattleboro, Vt.

PRESIDENTS OF THE ASSOCIATION.

Stephen Smith, M. D.....1872, '73, '74
*Joseph M. Toner, M. D..... 1875
*Edwin M. Snow, M. D..... 1876
*John H. Rauch, M. D..... 1877
*Elisha Harris, M. D..... 1878
*James L. Cabell, M. D..... 1879
John S. Billings, M. D..... 1880
*Charles B. White, M. D..... 1881
Robert C. Kedzie, M. D..... 1882
*Ezra M. Hunt, M. D..... 1883
Albert L. Gihon, M. D..... 1884
*James E. Reeves, M. D..... 1885
Henry P. Walcott, M. D..... 1886
George M. Sternberg, M. D..... 1887
Charles N. Hewitt, M. D..... 1888
*Hosmer A. Johnson, M. D..... 1889
Henry B. Baker, M. D..... 1890
Frederick Montizambert, M. D..... 1891
Felix Formento, M. D..... 1892
Samuel H. Durgin, M. D..... 1893
Emmanuel P. Lachapelle, M. D..... 1894
William Bailey, M. D..... 1895
Eduardo Licéaga, M. D..... 1896
Henry B. Horlbeck, M. D..... 1897
C. A. Lindsley, M. D..... 1898
*George H. Rohé, M. D..... 1899
Henry Mitchell, M. D..... 1899
Peter H. Bryce, M. D..... 1900

* Deceased.

EXECUTIVE COMMITTEE.

(The officers and ex-Presidents are *ex-officio* members of the Executive Committe.)

(ELECTIVE.)

Dr. IRVING A. WATSON.....Concord, N. H.
Dr. FRANK W. WRIGHT.....New Haven, Conn.
Dr. A. W. SUITER.....Herkimer, N. Y.
Dr. JOHN L. LEAL.....Paterson, N. J.
Dr. C. P. WILKINSON.....New Orleans, La.
Dr. J. F. KENNEDY.....Des Moines, Ia.

ADVISORY COUNCIL.

UNITED STATES:

Alabama.....
Arkansas.....
California.....
Colorado.....
Connecticut..... Dr. FRANK W. WRIGHT, *New Haven.*
Delaware.....W. C. R. COLQUHOUN, *Wilmington.*
Florida.....
Georgia.....
Illinois.....Dr. ADOLPH GEHRMANN, *Chicago.*
Indiana.....Dr. J. N. HURTY, *Indianapolis.*
Iowa.....Dr. JOHN C. SHRADER, *Iowa City.*
Kansas.....
Kentucky.....Dr. WM. BAILEY, *Louisville.*
Louisiana..... Dr. C. P. WILKINSON, *New Orleans.*
Maine.....Prof. FRANKLIN C. ROBINSON, *Brunswick.*
Maryland.....Dr. C. H. JONES, *Baltimore.*
Massachusetts..... Dr. S. H. DURGIN, *Boston.*
Michigan.....Dr. C. L. WILBUR, *Lansing.*
Minnesota.....Dr. F. F. WESBROOK, *Minneapolis.*
Mississippi.....
Missouri.....Dr. AMAND RAVOLD, *St. Louis.*
Nebraska.....
New Hampshire.....Dr. WM. K. ROBBINS, *Manchester.*
New Jersey.....Dr. JOHN LAINY LEAL, *Paterson.*
New Mexico.....
New York..... Dr. A. WALTER SUITER, *Herkimer.*
North Carolina.....Dr. S. W. BATTLE, *Asheville.*
North Dakota.....Dr. H. D. QUARRY, *Grand Forks.*
Ohio.....Dr. JOSIAH HARTZELL, *Canton.*
Oklahoma Territory....
Pennsylvania..... Mr. CROSBY GRAY, *Pittsburg.*
Rhode Island.....Dr. GARDNER T. SWARTS, *Providence.*
South Carolina..... Dr. H. B. HORLBECK, *Charleston.*
South Dakota.....
Tennessee.....
Texas..... Dr. JOHN HICKS FLORENCE, *Dallas.*
Vermont..... Dr. HENRY D. HOLTON, *Brattleboro.*
Virginia.....

Washington.....Dr. JAMES B. EAGLESON.
West Virginia.....
Wisconsin.....Dr. URANUS O. B. WINGATE.
District of Columbia....Dr. WILLIAM C. WOODWARD, *Washington, D. C.*
U. S .Army.....Dr. WALTER REED, *Washington, D. C.*
U. S. M. H Service.....Dr. EZRA K. SPRAGUE, *Washington, D. C.*
U. S. Navy.....Dr. T. J. TURNER, *Coldwater, Mich.*
Dominion of Canada....Dr. FREDERICK MONTIZAMBERT, *Ottawa.*
Province of Ontario....Dr. J. J. MACKENZIE, *Toronto.*
Province of Quebec....Dr. E. P. LACHAPELLE, *Montreal.*
Manitoba.....Dr. JAMES PATTERSON, *Winnipeg.*
New Brunswick.....Dr. G. E. COULTHARD, *Fredrickton.*
Nova Scotia.....

MEXICO:

Aguas Calinetes.....Dr. YSMAEL PRIETO, *Mexico, D. F.*
Campeche.....
Colima.....
Coahulia.....Dr. DAVID CERNA, *Saltillo.*
Chihuahua.....Dr. MIGUEL MARQUEZ, *Chihuahua.*
Chiapas.....
Durango.....Dr. JOSÉ L. GOMEZ, *Mexico, D. F.*
Guanajuato.....Dr. EDUARDO LICÉAGA, *Mexico, D. F.*
Guerrero.....
Hidalgo.....
Jalisco.....
Michoacan.....Dr. MANUEL GUTIERREZ, *Queretaro.*
Morelos.....Dr. JUAN N. CAMPOS, *Toluca.*
Mexico.....Dr. ROMAN RAMIREZ, *Mexico, D. F.*
Neuvo Leon.....
Oaxaca.....
Puebla.....
Querètaro.....Dr. MANUEL SEPTIEN, *Queretaro.*
San Luis Potisi.....Dr. JESUS E. MONJARÁS, *San Luis Potosi.*
Sonora.....
Sinaloa.....
Tabasco.....
Tamaulipas.....Dr. ANTONIO MATIENZO, *Tampico.*
Tlaxcala.....
Vera Cruz.....Dr. NARCISO DEL RIO, *Vera Cruz.*
Yucatan.....Dr. ADOLF PATRON MARTINEZ, *Merida.*
Zacatecas.....Dr. JUAN BREÑA, *Zacatecas.*
Territorio de la Baja Cal.
Territorio de Tepic.....
Distrito Federal.....Dr. JOSÉ RAMIREZ, *Mexico, D. F.*

PUBLICATION COMMITTEE.

Dr. C. O. PROBST.....Columbus, O.
Dr. JOSIAH HARTZELL.....Canton, O.
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Belcourt, Napoleon Antoine, Esq.	Ottawa, Ont.	1898

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BELLROSE, NORMAN W., M. D.....Eaton, Col. 1895
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BENOIT, EMMANUEL PERSILLIER, M. D.,
476 Sherbrooke St., Montreal, P. Q. 1894
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BERNALDEZ, FRANCISCO, M. D.....Estampa-Merced 5, Mexico, Mex. 1892
BESHOAR, MICHAEL, M. D.....Trinidad, Col. 1895
BILLINGS, JOHN S., M. D.....40 Lafayette Place, New York City. 1872
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BLACK, WILLIAM G.....Ottawa, Ont. 1897
BLACKWELL, EMILY, M. D.....53 E. 20th St., New York City. 1873
BOARDMAN, WM. FREARS.....Ottawa, Ont. 1898
BOSTWICK, W.....Ottawa, Ont. 1898
BOWERS, ABRAHAM H., M. D.....5 East 2d St., Jamestown, N. Y. 1896
BOYD, ELMER THOMAS, M. D.....Leadville, Col. 1895
BRACKEN, HENRY MARTYN, M. D.....1010 4th St., Minneapolis, Minn. 1895
BRADLEY, HARRY E., M. D.....208 Wisconsin St., Milwaukee, Wis. 1895
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BRAVA, CARLOS, M. D.....Colimo, Mex. 1896
BRAY, CHARLES W., M. D.....Portland, Me. 1894
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BROWN, H. D., M. D.....79 Market St., Potsdam, N. Y. 1896
BROWN, JOSEPH O.....Pittsburg, Pa. 1888
BRUMBAUGH, GAIUS M., M. D.....904 Mass. Ave., Washington, D. C. 1896
BRUNNER, WILLIAM FRANCIS, M. D.....50 Harris St., Savannah, Ga. 1890
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BUCK, ERASTUS J., M. D.....Platteville, Wis. 1888
BUCKE, R. M., M. D.....London, Ont. 1898
BURN, GEORGE.....Ottawa, Ont. 1898
BURNS, R. G., M. D.....72 Ohio St., Allegheny, Pa. 1897
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CAMPBELL, JAMES, M. D.....Hartford, Conn. 1888
CAMPBELL, WILLIAM ROBERTSON, M. D.,
34 Niagara St., Niagara Falls, N. Y. 1896
CANDEE, JAMES WILLIS, M. D.....402 Warren St., Syracuse, N. Y. 1896
CANTWELL, A. W., M. D.....Davenport, Iowa. 1880
CARMONA, LUIS S., M. D.....Mexico, Mex. 1896

CARMONA Y VALLE, MANUEL, M. D.....Mexico, Mex. 1892
CARTER, EDWIN H., M. D.....Des Moines, Iowa. 1896
CATELLIER, LAURENT, M. D.....31 Dauphine St., Quebec, P. Q. 1894
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CERNA, DAVID, M. D.....Galveston, Tex. 1896
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CHAGNON, ELOI PHILIPPE, M. D.....Longue Pointe, P. Q. 1894
CHAILLÉ, Prof. STANFORD E.....New Orleans, La. 1874
CHANDLER, Prof. C. F.....Columbia College, New York City. 1872
CHANDLER, DAVID D.....74 No. 7th St., Newark, N. J. 1896
CHAPIN, CHARLES V., M. D.....Providence, R. I. 1886
CHASE, HERMAN L., M. D.....Brookline, Mass. 1895
CHASE, JOHN, C., C. E.....Derry, N. H. 1890
CHICO, JÉSUS. M. D., 2 Estrella St., Guanajuato City, Guanajuato, Mex. 1891
CHURCH, C. R., M. D.....Ottawa, Ont. 1898
CHURCH, THOMAS TEASDALE, M. D.....70 E. Main St., Salem, Ohio. 1890
CLARK, HARRY W.....State House, Boston, Mass. 1896
CLARK, JOSEPH C., M. D.....15 Lawreno St., Olean, N. Y. 1896
CLARKE, A. P., M. D.....825 Mass. Ave., Cambridge, Mass. 1887
CLUFF, WM. H.,.....Ottawa, Ont. 1898
COFFEY, JAMES C.....Worcester, Mass. 1896
COLLINS, C. S., M. D.....Nashua, N. H. 1896
COLQUHOUN, W. C. R.....Wilmington, Del. 1894
COLUMBUS MEDICAL LIBRARY...Columbus Memorial Bldg., Chicago, Ill. 1897
COMEGYS, J. P., M. D.....Rock Island, Ill. 1897
CONN, G. P., M. D.....Concord, N. H. 1875
CONNELL, WALTER THOMAS, M. D.....Kingston, Ont. 1898
CONNELLY, R. N., M. D.....Newark, N. J. 1898
CONNIFF, ROBERT E., M. D.....Sioux City, Iowa. 1897
CONNER, P. S., M. D.....Cincinnati, Ohio. 1884
CONSTANTINEAU, Rev. J. A.....Ottawa, Ont. 1898
CONTRERAS, ANGEL, M. D.....Mesones 7, Puebla, Puebla, Mex. 1892
COOK, RICHARD J.....316 Chestnut St., Philadelphia, Pa. 1897
COOKE, S. P., M. D.....Ottawa, Ont. 1898
COPLIN, WILLIAM L.....1419 So. Broad St., Philadelphia, Pa. 1897
CORNELL UNIVERSITY.....Ithaca, N. Y. 1897
CORWIN, RICHARD W., M. D.....Pueblo, Col. 1895
COULTHARD, GEORGE EDWIN, M. D..18 Carleton St., Fredericton, N. B. 1894
COVENTRY, JOHN W., M. D.....Windsor, Ont. 1886
CRAIG, G. G., M. D.....Rock Island, Ill. 1880
CROSS, J. JAMES R., C. E.....68 Broad St., New York City. 1877
CROUCH, HENRY COOPER, M. D.....Denver, Col. 1895
CUMMINS, WILLIAM M., M. D.....Los Animos, Col. 1895
CURRIER, DAVID M., M. D.....Newport, N. H. 1883
CURTIS, GEORGE FRANCIS, M. D.....West Newton, Mass. 1897
CURTIS, F. C., M. D.....Albany, N. Y. 1883

DALBY, WILLIAM THOMAS, M. D.....Salt Lake City, Utah. 1894
DANIELL, R. P., M. D.....Jacksonville, Fla. 1890
DARR, HIRAM H., M. D.....Caldwell, Tex. 1883
DAVIS, FLOYD, Ph. D.....Des Moines, Iowa. 1890
DAVIS, N. S., M. D.....65 Randolph St., Chicago, Ill. 1887

Dean, William H., E. M., A. C....89 West River St., Wilkesbarre, Pa. 1896
DeCourcy, James Osbourne, M. D.....St. Liborg, Ill. 1895
Deery, J., M. D.....Betz Building, Philadelphia, Pa. 1897
de Garay, Adrian, M. D.....Mexico, Mex. 1892
de la Garza, Juan F., M. D.....Laredo, Tamaulipas, Mex. 1896
de la Roché, C. P., M. D.....1578 Pine St., Philadelphia, Pa. 1897
Denison, Charles, M. D.....1625 Logan Ave., Denver, Col. 1895
Dennis, Laban, M. D.....30 Central St., Newark, N. J. 1877
Derby, William P., M. D.....66 Bacon St., Boston, Mass. 1896
de Schweinitz, Emil A., M. D.....Washington, D. C. 1896
DeWitt, C., M. D.....Fort Monroe, Va. 1895
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Dinsmor, S. M., M. D.....Keene, N. H. 1896
Dodge, William E., Jr.....11 Cliff St., New York City. 1874
Doty, Alvah H., M. D.....Quarantine, Staten Island, N. Y. 1896
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Drown, Thomas M., M. D.....South Bethlehem, Pa. 1887
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Dunham, E. K., M. D.....338 26th St., New York City. 1897
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Dunmire, G B., M. D.....1618 Spruce St., Philadelphia, Pa. 1897
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Eagleson, James B., M. D.....Burke Building, Seattle, Wash. 1896
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Egan, J. A., M. D.....Springfield, Ill. 1897
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Ellegood, R. G., M. D.....Concord, Del. 1897
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Emery, Z. Taylor, M. D.....831 Washington Ave., Brooklyn, N. Y. 1894
Emmert, Joseph M., M. D.....Atlantic, Iowa. 1897
Enright, I. C.....Ottawa, Ont. 1898
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Exline, James W., M. D.....Denver, Col. 1895
Exton, James A., M. D.....75 Beech St., Arlington, N. J. 1897

Fales, Frank L., C. E.....City Hall, Cincinnati, Ohio. 1893
Farnham, Edwin, M. D.....Cambridge, Mass. 1889
Farquar, A. B., Esq.....York, Pa. 1880
Fenner, Byron.....Westfield, N. Y. 1896
Fenno, Henry Marshall, M. D.....77 W. Main St., Rochester, N. Y. 1892
Fenton, Thomas H., M. D.....1319 Spruce St., Philadelphia, Pa. 1897
Ferguson, F., M. D.....20 W. 38th St., New York City. 1892
Fernandez, J. D., M. D.....Jacksonville, Florida. 1890
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Flick, Lawrence F., M. D.....736 Pine St., Philadelphia, Pa. 1890
Foote, Charles Jenkins, M. D.....26 Elm St., New Haven, Conn. 1895
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Foster, Eugene, M. D.....Augusta, Ga. 1881
Foster, George S.....Putney, Vt. 1893

Fowler, Joseph, M. D.....141 Delaware Ave., Buffalo, N. Y. 1896
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Fuller, George W..... 220 Broadway, New York City. 1892
Fulton, John S., M. D.....10 South St., Baltimore, Md. 1897

Gable, Isaac C., M. D.....26 South St., York, Pa. 1897
Gayon, José P., M. D.....Mexico, Mex. 1897
Garciadiego, Salvador, M. D.....Guadalajara, Jalisco, Mex. 1892
Gauntt, Franklin, M. D.....Burlington, N. J 1885
Gaviño, A., M. D.....Ratas No. 4, Mexico, Mex. 1891
Geddes, Mrs. Frederick L..... 413 The Valentine, Toledo, Ohio. 1897
Gehrmann, Adolph, M. D.....3816 Ellis St., Chicago, Ill. 1895
Gerhard, William Paul, C. E.....36 Union Square, New York City. 1880
Gerin, John, M. D.....68 North St., Auburn, N. Y. 1896
Gerrish, Frederic H., M. D.....Portland, Me. 1885
Gibson, J. I., V. S.....Denison, Iowa. 1898
Gifford, A., M. D.....917 Mass. Ave., Lawrence, Kans. 1895
Gifford, Willis B., M. D.....Attica, N. Y. 1896
Gihon, Albert L., M. D., U. S. N.....233 5th Ave., New York City. 1876
Gilbert, John, M. D.....Fall River, Mass. 1898
Goltra, John N., M. D.....441 Elmwood Ave., Buffalo, N. Y. 1896
Goodwin, R. S., M. D.....Thomaston, Conn. 1886
Grant, Sir James, M. D.....Ottawa, Ont. 1898
Groff, George G., M. D.....Union St., Lewisburgh, Pa. 1894
Graves, E. E., M. D.....Penacook, N. H. 1886
Gray, Crosby.....Pittsburgh, Pa. 1874
Gray, Henry R.....144 St. Lawrence Main, Montreal, P. Q. 1886
Gray, Samuel M., C. E.....174 Weybosset St., Providence, R. I. 1891
Greene, Mary E., M. D.....Lawrence Ave., Charlotte, Mich. 1896
Greene, Walter D., M. D.....385 Jersey St., Buffalo, N. Y. 1896
Griffith, Jefferson D., M. D.....Kansas City, Mo. 1891
Grover, Burton B., M. D.....Colorado Springs, Col. 1895
Guilbert, Edward A., M. D.....Dubuque, Iowa. 1890
Gutierrez, Manuel, M. D.....13 Aduana Vieja, Mexico, Mex. 1891

Hagey, Jacob Moyer, M. D.....Mt. Morris, N. Y. 1892
Hall, William R., M. D.....40 King St., Chatham, Ont. 1896
Hamilton, J. H., M. D.....Richford, Vt. 1891
Hanley, Lawrence G., M. D.....Seneca St., Buffalo, N. Y. 1896
Harrison, George Wood, M. D.....404 Second St., Ashland, Wis. 1896
Hart, James A., M. D.....802 N. Nevada Ave., Colorado Springs, Col. 1895
Hartzell, Josiah, Ph. D.....Canton, Ohio. 1895
Harwood, Edgar L.....Ottawa, Ont. 1898
Haskell, W. A., M. D.....Alton, Ill. 1883
Hazard, George Stevens, M. D.....Hollis, N. H. 1896
Hazen, Allen, C. E.....220 Broadway, New York City. 1892
Heckard, M. O., M. D.....1251 W. Madison St., Chicago, Ill. 1897
Heffron, John Lorenzo, M. D.....448 S. Salina St., Syracuse, N. Y. 1894
Henderson, Alex. Allan, M. D.....Ottawa, Ont. 1898
Hengerer, William.....Buffalo, N. Y. 1896
Herbert, Charles P.....Champ de Mars St., Montreal, P. Q. 1894

Hering, Rudolph, C. E.....100 Williams St., New York City. 1878
Herold, H. C. H., M. D.....Newark, N. J. 1898
Heron, J. H., M. D.....Salt Lake City, Utah. 1895
Hershey, Edgar P., M. D.....408 California Building, Denver, Col. 1895
Hewitt, Charles N., M. D.....Red Wing, Minn. 1872
Hicks, Charles A., M. D.....Fall River, Mass. 1897
Hill, G. Everett.....Newport, R. I. 1897
Hill, Hibbert W., M. D.....Sudbury and Hawkins Sts., Boston, Mass. 1896
Hill, John W., C. E.....35 Glenn Building, Cincinnati, Ohio. 1896
Hoadley, Carleton E., M. D.....116 Church St., New Haven, Conn. 1896
Hogan, Louise E.....75 W. 12th St., New York City. 1897
Holcombe, Charles Henry, M. D.....Brookline, N. H. 1894
Holt, Erastus Eugene, M. D.....723 Congress St., Portland, Me. 1894
Holton, Henry D., M. D.....Brattleboro, Vt. 1875
Homan, George, M. D.....919 Olive St., St. Louis, Mo. 1879
Hooper, William G., M. D.....Atlantic City, N. J. 1896
Hopkins, Henry R., M. D.....433 Franklin St., Buffalo, N. Y. 1894
Horetzsky, Chas. G., C. E.....Toronto, Ont. 1898
Horlbeck, H. B., M. D.....Charleston, S. C. 1880
Horton, Elmer G.....Columbus, Ohio. 1897
Hoskins, Horace D., D. V. S.....3452 Ludlow St., Philadelphia, Pa. 1897
Howe, Lucien, M. D.....183 Delaware Ave., Buffalo, N. Y. 1896
Hoyt, J. Elizabeth, M. D.....85 North State St., Concord, N. H. 1895
Hoyt, Henry F., M. D.....St. Paul, Minn. 1884
Huggins, William Q.....Sanborn, N. Y. 1896
Hughes, J. W.....747 Craig St., Montreal, P. Q. 1894
Hunt, A. Clark, M. D.....Metuchen, N. J. 1888
Hunt, C. C., M. D.....Dixon, Ill. 1889
Hunt, Simeon, M. D.....Warren Ave. and 2d St., E. Providence, R. I. 1896
Hurty, John N., M. D.....29 East Second St., Indianapolis, Ind. 1896

Irwell, Lawrence, M. A., B. C. L....76 W. Tupper St., Buffalo, N. Y. 1896
Irwin, Fairfax, M. D.....410 Chestnut St., Philadelphia, Pa. 1897

Jackson, Edward, M. D.....1633 Locust St., Philadelphia, Pa. 1897
Jackson, Frank S., M .D.....Dunkirk, N. Y. 1896
Jackson, William H., M. D.....38 Main St., Springville, N. Y. 1896
Jacques, F. H.....Ottawa, Ont. 1898
James, Bushrod W., M. D...Cor. 18th and Green Sts., Philadelphia, Pa. 1878
Jenkins, William T., M. D.....New York, N. Y. 1892
Johnston, Wyatt, M. D.....76 Rue Ste. Gabriel, Montreal, P. Q. 1892
Johnson, C. B., M. D.....Champaign, Ill. 1897
Jones, C. Hampson, M. D.....211 W. Franklin St., Baltimore, Md. 1898
Jones, Leander P., M. D.....Greenwich, Conn. 1889
Jones, S. Case, M. D.....21 East Ave., Rochester, N. Y. 1895
Jordan, Edward C., C. E.....3½ Exchange St., Portland, Me. 1886

Kahle, R. D., M. D.....Lima, Ohio. 1898
Kahn, Lee, M. D.....501 Harrison Ave., Leadville, Col. 1894
Keefer, C. H., C. E.....Ottawa, Ont. 1896
Kemper, J. F., M. D.....Des Moines, Iowa. 1896
Keller, Wilhelm H., M. D.....Stony Point, N. Y. 1896
Kellogg, J. H., M. D.....Battle Creek, Mich. 1878

KENNEDY, J. F., M. D.....Des Moines, Iowa. 1885
KARSNER, CHARLES W., M. D.....1320 So. Broad St., Philadelphia, Pa. 1897
KIMBALL, JAMES P., M. D., U. S. A.....Omaha, Neb. 1892
KINGSLEY, BYRON F., M. D..Cor. Elm and Starr Sts., San Antonio, Tex. 1892
KINYOUN, J. J., M. D., U. S. M. H. S.....Washington, D. C. 1895
KIRKPATRICK, THOMAS, M. D.....821 Kansas Ave., Topeka, Kan. 1895
KNOX, S. P. B., M. D.....912 Anacapa, Santa Barbara, Cal. 1892
KNOX, WILLIAM F., M. D.....McKeesport, Pa. 1887
KNOPF, S. A., M. D.....16 West 95th St., New York City. 1897
KOBER, GEORGE M., M. D.....1819 Q St., Washington, D. C. 1896
KUICHLING, EMIL, C. E.....Rochester, N. Y. 1882

LACHAPELLE, EMANUEL P., M. D.....Montreal, P. Q. 1887
LAINE, J. R., M. D.....913 K St., Sacramento, Cal. 1895
LAW, Prof. JAMES.....Ithaca, N. Y. 1872
LEAL, ALBERTO.....Guanajuato, Mex. 1897
LEAL, JOHN LAINY, M. D.....149 Ellison St., Paterson, N. J. 1891
LEARNED, JOHN B., M. D.....Northampton, Mass. 1889
LEE, BENJAMIN, M. D.....1532 Pine St., Philadelphia, Pa. 1874
LEITER, L. Z., Esq.....P. O. Drawer L, Chicago, Ill. 1876
LEIGHTON, MARSHALL.....Montclair, N. J. 1897
LEMP, WILLIAM T.....St. Louis, Mo. 1884
LEROY, ROBERT, M. D.....Denver, Col. 1895
LETHWORTH, Hon. WILLIAM P.....Glen Iris, Portageville, N. Y. 1874
LEWIS, DANIEL, M. D.....249 Madison Ave., New York City. 1894
LEWIS, D. O., M. D.....1628 Market St., Philadelphia, Pa. 1897
LEWIS, FRANCIS W., M. D.....2016 Spruce St., Philadelphia, Pa. 1874
LEWIS, G. E. ROSS.....1912 Logan Ave., Denver, Col. 1895
LEWIS, RICHARD H., M. D.....Raleigh, N. C. 1892
LIBRARY OF PRATT INSTITUTE.....Remsen St., Brooklyn, N. Y. 1897
LICÉAGA, EDUARDO, M. D.....4 San Andres St., Mexico, Mex. 1891
LILLEY, JOSIAH K.....Indianapolis, Ind. 1897
LINDSLEY, CHARLES A., M. D.....New Haven, Conn. 1875
LINSLEY, Jo. H., M. D.....Burlington, Vt. 1898
LIPPERT, MORITZ, C. E.....Phoenixville, Pa. 1897
LOAIZA, RAFAEL, M. D.....Tlaxcala, Mex. 1896
LOGAN, GEO., M. D.....Ottawa, Ont. 1898
LOREK, THOMAS, M. D.....Zacatecas, Mex. 1895
LUMSDEN, ALEXANDER.....Ottawa, Ont. 1898
LUMSDEN, W. J., M. D.....Elizabeth City, N. C. 1892

MACCABE, JNO. ALEXANDER, LL. D.....Ottawa, Ont. 1898
MCCLELLAN, EZRA S., M. D.....Saranac Lake, N. Y. 1889
MCCLELLAND, J. H., M. D.....5th and Wilkins Ave., Pittsburg, Pa. 1885
MCCORMACK, J. N., M. D.....Bowling Green, Ky. 1880
MCCRIMMON, MILTON, M. D.....Palermo, Ont. 1894
MCFARLAND, JOSEPH, M. D.....1314 Franklin St., Philadelphia, Pa. 1897
MACFARLANE, THOMAS.....Ottawa, Ont. 1898
MCGAILLARD, BENJAMIN, M. D.....229 East State St., Trenton, N. J. 1897
MCGREGOR, GEORGE WILBUR, M. D.....Littleton, N. H. 1894
MCHUGH, PETER J., M. D.....Fort Collins, Col. 1895
MCKENZIE, THOMAS H., C. E.....Southington, Conn. 1893

McKinley, John, S. C., M. D.....Ottawa, Ont. 1898
McNeil, J. Henry, M. D.....33 Sheboygan St., Fond du Lac, Wis. 1896
McShane, James Francis, M. D.,
2 So. Patterson Park Ave., Baltimore, Md. 1892
McTavish, D. B., Esq.....Ottawa, Ont. 1898
MacDonald, John D., M. D.....28 Duke St., Hamilton, Ont. 1894
Mackenzie, John J., B. A.....Parliament Building, Toronto, Ont. 1894
Mackie, J. M., M. D.....Portage la Prairie, Manitoba. 1896
Macouzet, R., M. D.....Mexico, Mex. 1897
Marks, Solon, M. D.....Milwaukee, Wis. 1876
Marquardt, C. H., M. D.....La Crosse, Wis. 1893
Marquez, Miguel, M. D.....Chihuahua, Chihuahua, Mex. 1892
Marsh, E. J., M. D.....600 Park Ave., Paterson, N. J. 1872
Mason, Robert S., M. D.....Chester, Pa. 1897
Masson, Thomas, M. D.....Cape Vincent, N. Y. 1896
Mather, James.....Ottawa, Ont. 1898
Mathews, J. M., M. D.....923 4th St., Louisville, Ky. 1895
Matthews, W. E., M. D.....Johnstown, Pa. 1897
May, Geo. S.....Ottawa, Ont. 1898
Mead, Daniel Webster, C. E.....1st Nat. Bank Bldg., Chicago, Ill. 1892
Mead, Julian Augustus, M. D.....Irving St., Watertown, Mass. 1896
Mendizabal, G., M. D.....Orizaba, Mex. 1893
Mercer, Alfred, M. D.....Syracuse, N. Y. 1886
Miller, Katherine, M. D.....Lincoln, Ill. 1892
Mitchell, Henry, M. D.....Asbury Park, N. J. 1886
Mitchell, William Francis, M. D.....Lancaster, Mo. 1892
Mohr, Charles, M. D.....1828 Green St., Philadelphia, Pa. 1897
Monjarás, Jésus E., M. D.....Cinco de Mayo, San Luis Potosi, Mex. 1891
Monjeau, C., C. E.....Middletown, Ohio. 1887
Montgomery, John, M. D.....Ardoch, N. D. 1895
Montgomery, L. H., M. D.....70 State St., Chicago, Ill. 1879
Montizambert, Frederick, M. D.....Ottawa, Ont. 1885
Moore, Veranus A., M. D.....Veterinary College, Ithaca, N. Y. 1896
Moore, Wm., D. D.....Ottawa, Ont. 1898
Morales, José Donaciano, M. D.,
Hospicio San Nicholes 13, Mexico, Mex. 1892
Morgan, David Percy.....Box 2036, New York City. 1885
Morris, John, M. D.....118 E. Franklin St., Baltimore, Md. 1874
Morris, Moreau, M. D.....109 E. 73d St., New York City. 1896
Morse, William F., S. E.....287 4th St., New York City. 1889
Mosher, Eliza M., M. D.....Ann Arbor, Mich. 1889
Muldoon, J., M. D.....San Juan Bautista, Tabasco, Mex. 1896
Mulford, Henry K.....412 So. 13th St., Philadelphia, Pa. 1896
Mullen, Alexander J., Jr., M. D.,
409 Washington St., Michigan City, Mich. 1892
Munn, William P., M. D.....709 Fourteenth St., Denver, Col. 1895
Murray, Robert D., M. D., U. S. M. H. S.....Key West, Fla. 1872
Nagle, John T., M. D.....47 East 21st St., New York City. 1874
Nash, Herbert M., M. D.....Norfolk, Va. 1878
Neff, J. L., M. D.....Mutual Life Bldg., Philadelphia, Pa. 1897
New York State Library.....Albany, N. Y. 1897
Nesbitt, Beatty, M. D.....Toronto, Ont. 1897

NEWELL, F. H.....U. S. Geological Survey, Washington, D. C. 1897
NEWTON, WM. K., M. D.....Paterson, N. J. 1883
NEW YORK PUBLIC LIBRARY.....40 Lafayette Place, New York, N. Y. 1898
NORIEGA, ALBERTO, M. D.....Hermosillo, Sonora, Mex. 1891
NORIEGA, TOMAS, M. D.....Hospital de Jésus, Mexico, Mex. 1892
NUNN, R. J., M. D.....114½ York St., Savannah, Ga. 1881
NUTTALL, GEORGE H. F., M. D.,
Pathological Laby. New Museums, Cambridge, Eng. 1891
O'HARA, MICHAEL, M. D.....31 South St., Philadelphia, Pa. 1897
ORTON, JOHN G., M. D.....Binghampton, N. Y. 1890
ORVANAÑOS, DOMINGO, M. D.....25 Chavarria St., Mexico, Mex. 1890
OSBORNE, EDWIN C., M. D.....49 Nassau St., Princeton, N. J. 1897
OTIS, EDWARD OSGOOD, M. D..308 Commonwealth Ave., Boston, Mass. 1894

PADDOCK, FRANK K., M. D.....Box 1183, Pittsfield, Mass. 1889
PAPINEAU, LOUIS GUSTAVE, C. E....369 St. Denis St., Montreal, P. Q. 1894
PAQUIN, PAUL, D. V. S.....3536 Olive St., St. Louis, Mo. 1891
PARKER, T. E., M. D.....Woodbury, N. J. 1897
PARSONS, WILLIAM M., M. D.....Manchester, N. H. 1897
PATTERSON, JAMES, M. D.....277 Donald St., Winnipeg, Manitoba. 1894
PATTON, GEORGE FARRAR, M. D.....1134 Camp St., New Orleans, La. 1896
PEARSON, LEONARD, V. M. D.....Harrisburg, Pa. 1897
PEASE, HERBERT D., M. D.....Buffalo, N. Y. 1897
PECK, GEORGE, M. D.. U. S. N.....926 No. Broad St., Elizabeth, N. J. 1890
PELLETIER, ELZÉAR, M. D.....Montreal, P. Q. 1892
PERLEY, Mrs. W. G.....Ottawa, Ont. 1898
PERRY, THOMAS B., M. D., P. A. Surgeon, U. S. M. H. S.,
San Francisco, Cal. 1896
PHELAN, THOMAS F., M. D.....Orange, N. J. 1897
PIERCE, J. S.....Ardmore, Pa. 1897
PLUNKET, J. D., M. D.....Nashville, Tenn. 1878
POINDEXTER, J. D., M. D., U. S. A.....Fort Hamilton, N. Y 1896
PORTER, JOSEPH Y., M. D.....Jacksonville, Fla. 1878
POULIN, STANISLAS REMI, C. E.....Ottawa, Ont. 1898
POWELL, C. BERKELEY, M. D.....Ottawa, Ont. 1898
POWELL, FRED. HAMILTON, M. D.....Ottawa, Ont. 1898
PRATT, PASCAL P.....736 Main St., Buffalo, N. Y 1896
PRAY, SUSAN REMSEN, M. D.....191 So. Ninth St., Brooklyn, N. Y. 1896
PRESTON, R. H., M. D.....Ottawa, Ont. 1898
PRITCHARD, MAURICE, M. D.....Sierra Valley, Cal. 1893
PROBST, C. O., M. D.....Columbus, Ohio. 1886
PROVOST, L. COYTEUX, M. D.....Ottawa, Ont. 1898

RAMIREZ, JOSÉ, M. D.....Plazuela Buena Vista 1626, Mexico, Mex. 1892
RAMIREZ, ROMAN, M. D.....Taculaye St., Mexico, Mex. 1898
RAMSEY, DOUGLAS C., M. D.....Mount Vernon, Ind. 1894
RAVENEL, M. P., M. D.....Philadelphia, Pa. 1897
RAVENEL, WILLIAM C., M. D.....Charleston, S. C. 1890
RAVOLD, AMAND, M. D.....St. Louis, Mo. 1897
RAWSON, ALLEN A., M. D.....Corning, Iowa. 1892
RAYMOND, JOSEPH H., M. D....L. I. College Hospital, Brooklyn, N. Y. 1882
REEVE, J. T., M. D.....Appleton, Wis. 1876

Reid, Alex P., M. D.....Halifax, N. S. 1894
Reilly, F. W., M. D.....Room 2, City Hall, Chicago, Ill. 1896
Reyes, Augustin, M. D.....Mexico, Mex. 1892
Reynolds, A. R., M. D.....City Hall, Chicago, Ill. 1893
Richards, Edgar.....341 W. 88th St., New York City. 1889
Richards, Mrs. E. H.....Institute of Technology, Boston, Mass. 1888
Richardson, Maj. Henry B., C. E.....New Orleans, La. 1880
Rchardson, W. L., M. D.....225 Commonwealth Ave., Boston, Mass. 1875
Riddle, George, M. D.....Crystal City, Manitoba. 1895
Rives, William C., M. D.....1723 I St., Washington, D. C. 1885
Roberts, Charles F., M. D.....New York City. 1892
Robertson, Hon. Jas. W.....Ottawa, Ont. 1898
Roberts, Hon. James A.....Mooney Building, Buffalo, N. Y. 1896
Robillard, Adolphe, M. D.....City Hall, Ottawa, Ont. 1896
Robinson, Prof. Franklin C.....Brunswick, Me. 1889
Robinson, John Franklin, M. D.....Manchester, N. H. 1894
Rogers, Francis J., M. D.....Stamford, Conn. 1889
Russell, Julia Wallace, M. D.....44 Pleasant St., Concord, N. H. 1892

Sala, E. M., M. D.....1807 5th Ave., Rock Island, Ill. 1896
Salmon, D. E., D. V. M.....Washington, D. C. 1883
Samaniego, Jos. A., M. D.....Ciudad Juarez, Chihuahua, Mex. 1892
Sanchez, Francisco, M. D.....Puebla, Puebla, Mex. 1892
Santa-Maria, Carlos, M. D.....Durango, Mex. 1896
Saunders, Wm., M. D.....Experiment Farm, Ottawa, Ont. 1898
Schenck, W. L., M. D.....Topeka, Kan. 1891
Schmid, Henry Ernest, M. D.....White Plains, N. Y. 1896
Schoellkopf, Hon. Arthur.....Niagara Falls, N. Y. 1896
Schoonover, Warren, M. D.....115 East 59th St., New York City. 1895
Schmuck, J. Carl, M. D.....Lawrence, Staten Island. 1897
Scott, Richard W., Esq.....Ottawa, Ont. 1898
Scribner, Mrs. John H.....Chestnut Hill, Philadelphia, Pa. 1897
Scull, Henry S., M. D.....Atlantic City, N. J. 1896
Sears, John H., M. D.....Waco, Tex. 1887
Sears, Frederick, M. D.....506 Warren St., Syracuse, N. Y. 1897
Septien, Manuel, M. D.....Queretaro, Mex. 1898
Sewall, Henry, M. D.....23 Eighteenth Ave., Denver, Col. 1894
Shaffer, A. W., C. E.....Raleigh, N. C. 1898
Shakespeare, E. O., M. D.....Rosemont, Pa. 1897
Shenk, W. L., M. D.....New Castle, Col. 1895
Shepard, Charles H., M. D.....Columbia Heights, Brooklyn, N. Y. 1892
Shepherd, George R., M. D.....667 Asylum St., Hartford, Conn. 1886
Shiard, Charles, M. D.....Toronto, Ont. 1896
Shillito, G. M., M. D.....Roup St., Pittsburgh, Pa. 1892
Shrader, John C., M. D.....Iowa City, Iowa. 1890
Shutt, Frank Thomas.....Experimental Farm, Ottawa, Ont. 1898
Shuttleworth, Edward B., M. D....220 Shartowne St., Toronto, Ont. 1895
Silva, M. O., M. D.....Morelia, Mex. 1892
Slee, Richard, M. D.....Swiftwater, Pa. 1897
Small, Henry Beaumont, M. D.....Ottawa, Ont. 1898
Smart, Charles, M. D., U. S. A.....Washington, D. C. 1882
Smelzer, Baxter T., M. D.....229 Hamilton St., Albany, N. Y. 1895

Smith, Charles D., M. D.....Portland, Me. 1885
Smith, Frederick W., M. D.....700 S. West St., Syracuse, N. Y. 1896
Smith, J. Sol., M. D.....Denver, Col. 1895
Smith, Joel W., M. D.....Charles City, Iowa. 1888
Smith, Stephen, M. D.....640 Madison Ave., New York City. 1872
Smith, T. Guilford.....Ellicott Sq., Buffalo, N. Y. 1896
Somerman, Mariano, M. D.....Guadalajara, Mex. 1897
Sparks, Miss Sarah.....Ottawa, Ont. 1898
Spencer, James D., M. D.....59 Washington St., Watertown, N. Y. 1896
St. Jean, P., M. D.....Ottawa, Ont. 1898
Standlee, Eli L., M. D.....2201 University Pl., St. Louis, Mo. 1895
Stanton, Byron, M. D.....Cincinnati, Ohio. 1889
Staples, Franklin, M. D.....Winona, Minn. 1885
Starkweather, Ralph E., M. D.....5151 Cornell Ave., Chicago, Ill. 1879
Stedman, Arnold, M. D.....722 14th St., Denver, Col. 1895
Sternberg, George M., M. D., U. S. A.....Washington, D. C. 1874
Stewart, Francis E., M. D.,
Merck Building, University Place, New York City. 1897
Stewart, A. H., M. D.....252 No. 12th St., Philadelphia, Pa. 1897
Stull, Theodore B.....City Hall, Philadelphia, Pa. 1897
Suiter, A. Walter, M. D.....Herkimer, N. Y. 1894
Sutherland, Quincy Orlin, M. D..73 Milwaukee St., Janesville, Wis. 1895
Sutton, H. C., M. D.....220 N. James St., Rome, N. Y. 1896
Swarts, Gardner Taber, M. D.....Providence, R. I. 1894
Sweetland, John, M. D.....Ottawa, Ont. 1898
Swope, Samuel D., M. D.....Deming, N. M. 1895

Talbot, Miss Marion.....University of Chicago, Chicago, Ill. 1893
Teichmann, William C., Ph. D.....1141 Market St., St. Louis, Mo. 1896
Ten Wergesy, Charles H., M. D.....Wilmington, Del. 1897
Thibaudeau, Hon. Joseph Rosaire.....857 Palace St., Montreal, P. Q. 1894
Thompson, J. G., M. D.....Angola, N. Y. 1896
Thompson, S. J.....Third Ave., Carbeny, Manitoba. 1896
Thompson, William, M. D.....1426 Walnut St., Philadelphia, Pa. 1897
Thornton, G. B., M. D.....Memphis, Tenn. 1879
Towne, S. R., M. D.....Omaha, Neb. 1895
Tracy, Roger S., M. D.....151 West 106th St., New York City. 1889
Traver, Lorenzo, M. D.....5 Stewart St., Providence, R. I. 1892
Tucker, H. G,. M. D.....1270 N. Vine St., Nashville, Tenn. 1896
Turner, Thomas J., M. D., U. S. N.....Coldwater, Mich. 1877
Turnbull, Lawrence, M. D.....255 So. 17th St., Philadelphia, Pa. 1897
Turnbull, Thomas, M. D.....314 Western Ave., Allegheny, Pa. 1897

Utley, Edward R., M. D.....Newton, Mass. 1898

Valade, F. X., M. D.....Ottawa, Ont. 1898
Valentine, Fred C., M. D.....31 W. 6th St., New York, N. Y. 1896
Van Buskirk, W. F., C. E.....Stratford, Ont. 1896
Van Doren, Clarence T.....Harrison, N. J. 1898
Vanier, Joseph Emile, I. C.....107 St. James St., Montreal, P. Q. 1894
Van Norman, E. V., M. D.....Los Angeles, Cal. 1882
Vaux, Harry E., M. D.....Brockville, Ont. 1894
Veeder, Major Albert, M. D.....12 Queen St., Lyons, N. Y. 1896

VEEDER, ANDREW TRAUX, M. D..Home Office Building, Pittsburgh, Pa. 1896
VERGE, W. A., M. D.....Quebec, P. Q. 1894
VINNEDGE, W. W., M. D.....Layfayette, Ind. 1882

WADE, JOHN W., M. D.....318 No. 2d St., Millville, N. J. 1897
WADE, SPENCER S., M. D.....Morgantown, W. Va. 1892
WAKEMAN, B. R., M. D.....73 Main St., Hornellsville, N. Y. 1896
WALCOTT, HENRY P., M. D.....Cambridge, Mass. 1880
WALKER, CHARLES R., M. D.....Concord, N. H. 1894
WALSH, RALPH, M. D.....Washington, D. C. 1885
WALLACE, SHIPPEN, M. D.....113 Walnut St., Burlington, N. J. 1897
WARD, L. B., C. E.....702 St. Nicholas Ave., New York City. 1885
WARDLOW, JAMES S., M. D.....Galt, Ont. 1896
WATSON, IRVING A., M. D.....Concord, N. H. 1881
WATSON, J. MADISON, M. D.....Elizabeth, N. J. 1882
WATT, ALFRED TENNYSON, M. D.....Victoria, B. C. 1896
WEDGEWOOD, MILTON C., M. D.....101 Pine St., Lewiston, Me. 1894
WELCH, WILLIAM, M. D.....821 No. Broad St., Philadelphia, Pa. 1897
WENDE, ERNEST, M. D.....296 Water St., Buffalo, N. Y. 1894
WESBROOK, FRANK F., M. D.....Minneapolis, Minn. 1897
WESTON, ROBERT SPURR.....14 Beacon St., Boston, Mass. 1896
WHITE, ALFRED T., M. D.....Box 619, New York City. 1889
WHITE, WILLIAM A., M. D.....Box 619, New York City. 1888
WHITESIDES, LINDSAY S., M. D.....Franklin, Ind. 1894
WHITMORE, WALTER S., M. D.....17 Broad St., Red Bank, N. Y. 1896
WIELAND, J. W., M. D.....1993 Cowles Ave., Dubuque, Iowa. 1894
WILBUR, CRESSY L., M. D.....Lansing, Mich. 1894
WILKINSON, C. P., M. D.....New Orleans, La. 1889
WILLIAMS, ANNIE W., M. D.....1235 Vine St., Denver, Col. 1895
WILSON, EZRA H., M. D.....Hoagland Laboratory, Brooklyn, N. Y. 1897
WILSON, G. H., M. D.....50 Colony St., Meriden, Conn. 1890
WILSON, WILLIAM A., M. D.....310 Paris Ave., Grand Rapids, Mich. 1896
WINGATE, URANUS OWEN BRACKETT, M. D.,
204 Biddle St., Milwaukee, Wis. 1890
WINTER, HERMAN, M. D.....Buffalo, N. Y. 1896
WISE, SIMON P., M. D.....Millersburg, Ohio. 1886
WITHROW, JOHN M., M. D.....526 W. 7th St., Cincinnati, Ohio. 1897
WODDROP, L. H.....1458 No. 15th St., Philadelphia, Pa. 1897
WOOD, ALFRED VINCENT.....1777 Gloucester St., Brunswick, Ga. 1892
WOOD, E. M., M. D.....Winnipeg, Manitoba. 1897
WOOD, Prof. EDWARD S.....Harvard Medical School, Boston, Mass. 1895
WOODBRIDGE, JOHN ELIOT, M. D.....637 Prospect St., Cleveland, Ohio. 1896
WOODBRIDGE, Prof. S. H.....Boston, Mass. 1895
WOODCOCK, GALEN MURRAY, M. D.....17 Adams St., Bangor, Me. 1896
WOODHULL, Lieut.-Col. A. A., M. D., U. S. A.....Washington, D. C. 1874
WOODWARD, C. R.....Cairo, Ill. 1896
WOODWARD, WILLIAM C., M. D.....Washington, D. C. 1896
WORCESTER FREE LIBRARY.....Worcester, Mass. 1897
WORDIN, NATHANIEL EUGENE, M. D.,
174 Fairfield Ave., Bridgeport, Conn. 1890
WRIGHT, FRANK W., M. D.....48 Pearl St., New Haven, Conn. 1889
WRIGHT, H. P., M. D.....Ottawa, Ont. 1898

Wright, John W., M. D.....Erie, Pa. 1897
Wroth, James Henry, M. D.....Albuquerque, N. M. 1896
Wyckoff, C. C., M. D.....482 Delaware Ave., Buffalo, N. Y. 1896
Wyckoff, Richard M., M. D.....532 Clinton Ave., Brooklyn, N. Y. 1894
Wyman, Walter, M. D., U. S. M. H. S.....Washington, D. C. 1884

Young, A. G., M. D.....Augusta, Me. 1885

Zertuche, Emilio, M. D.....Puebla, Mex. 1897

HONORARY MEMBERS.

Ex-President Grover Cleveland.....Princeton, N. J. 1885
J. B. Russell, M. D., LL.D.....Glasgow, Scotland. 1886
Mrs. Elizabeth Thompson.....New York City. 1887
President Porfirio Diaz.....Mexico, Mex. 1892

LIFE MEMBER.

Henry Lomb.....Rochester, N. Y. 1884

MEMBERS ELECTED AT MINNEAPOLIS MEETING, OCTOBER 31, NOVEMBER 1, 2, 3, 1899.

Allen, Wm. Harvey.....University of Pennsylvania, Philadelphia, Pa.
Alvord, J. W., C. E.....127 Hartford Building, Chicago, Ill.

Bailey Alfred W., M. D.....Atlantic City, N. J.
Beard, Richard O., M. D.....Minneapolis, Minn.
Baldwin, E. R., M. D.....Saranac Lake, N. Y.
Bell, Gordon, M. D.....Winnipeg, Manitoba.
Board of Health.....Erie, Pa.
Board of Health.....Manchester, N. H.
Brackett, C. F., M. D.....Princeton, N. J.
Bradley, A. E., M. D.....Washington, D. C.
Brown, Edward J., M. D.....Minneapolis, Minn.

Campos, Juan N., M. D.....Mexico, Mex.
Clark, J. Fred, M. D.....Fairfield, Ia.
College of Medicine.....Syracuse University, Syracuse, N. Y.
Connolly, R. N., M. D.....Newark, N. J.
Corlett, J. F., M. D.....Minneapolis, Minn.
Correll, H. C.....Kingston, Ont.
Craven, Macdonough, C. E.....263 82d St., Brooklyn, N. Y.

del Rio, Narciso, M. D.....Vera Cruz, Mex.
Disbrow, Wm. S., M. D.....Newark, N. J.
Drew, Charles W., M. D.....Minneapolis, Minn.

Emerson, H. C., M. D.....Springfield, Mass.
Ernst, Harold C., M. D.....Harvard Medical School, Boston, Mass.

Florence, John H., M. D.....Dallas, Texas.
Foster, Chas. F.....Health Board, New York, N. Y.
Freeman, R. G., M. D.....478 W. 59th St., New York, N. Y.
Frost, Prof. Wm. D.....Madison, Wis.

Gibson, J. I., V. S.....Denison, Ia.
Gilbert, John, M. D.....Fall River, Mass.
Gomez, J. de la, M. D.....Mexico, Mex.
Gorham, Fred P.....Providence, R. I.

Harris, Norman McL., M. D.....Baltimore, Md.
Hektoen, Ludwig, M. D.....Rush Medical College, Chicago, Ill.
Hiss, Philip H., Jr., M. D.....Washington Sq. No., New York, N. Y.
Holmes, A. Mansfield, M. D.....Denver, Col.
Hohenschuh, W. P.....Iowa City, Ia.
Hunter, Chas. H., M. D.....Minneapolis, Minn.
Hutchinson, Henry, M. D.....St. Paul, Minn.
Huddleston, J. H., M. D.....126 W. 85th St., New York, N. Y.

Jackson, Daniel D.,
Flatbush Ave. and Eastern Parkway, Brooklyn, N. Y.
Jones, S. S., M. D.....Frazee, Minn.
Jordan, E. O.....University of Chicago, Chicago, Ill.

Kelso, Wilbur M.....5833 Monroe Ave., Chicago, Ill.
Kinnicutt, Leonard P.....Worcester, Mass.
Kneass, S. S., M. D.....1510 Walnut St., Philadelphia, Pa.

Laberge, L., M. D.....Montreal, P. Q.
Lartigan, J., M. D.....478 W. 59th St., New York, N. Y.

McKlveen, John A., M. D.....Chariton, Ia.
Martinez, A. P., M. D.....Mérida, Mex.
Matienzo, Antonio, M. D.....Tampico, Mex.
Meade, Charles Arthur.....303 E. 18th St., New York, N. Y.
Murray, Archibald, M. D.....145 Clinton St., Brooklyn, N. Y.

Newman, G. A., M. D.....New London, Minn.
Norton, A. K., M. D.....Minneapolis, Minn.

Ohage, Justus, M. D.....St. Paul, Minn.

Pennsylvania R. R. Relief Dept.....Trenton, N. J.
Perkins, Jay, M. D.....Providence, R. I.
Preston, Charles, M. D.....Davenport, Ia.
Prieto, Ysmael, M. D.....Mexico, Mex.
Prudden, T. Mitchell, M. D.....437 W. 59th St., New York, N. Y.

Quarry, H. D., M. D.....Grand Forks, N. D.

Reed, Walter, M. D.....7 Cook Place, Washington, D. C.
Repp, John T., V. M. D.....Ames, Ia.
Reynolds, M. H., V. M. D.....St. Anthony Park, Minn.
Ripley, Martha G., M. D.....Minneapolis, Minn.
Rogers, A. C., M. D.....Faribault, Minn.
Russell, H. L.....Madison, Wis.

Simmons, Geo. H., M. D.....61 Market St., Chicago, Ill.
Smart, G. I., M. D.....Blue Earth, Minn.
Smersh, F. M., M. D.....Owatonna, Minn.

Sprague, E. K., M. D.....Washington, D. C.
Stillson, H. L., M. D.....Bennington, Vt.
Stokes, Wm. R., M. D.....Baltimore, Md.
Sweetser, H. B., M. D.....Minneapolis, Minn.
Suiter, F. C., M. D.....La Crosse, Wis.

Taylor, J. D., M. D.....Grand Forks, N. D.
Tenney, W. A. R., M. D.....Cincinnati, O.
Trudeau, E. L., M. D.....Saranac Lake, N. Y.

Warner, Frank, M. D.....Columbus, O.
Welch, Wm. H., M. D.....Baltimore, Md.
Whipple, Geo. C.....729 Carroll St., Brooklyn, N. Y.
Willcox, W. F.....Washington, D. C.
Wilson, L. B., M. D.....Minneapolis, Minn.
Wright, James H., M. D.....Boston, Mass.

SANITARY AUTHORITIES AND ASSOCIATIONS

OF THE

UNITED STATES OF AMERICA, THE DOMINION OF CANADA, AND THE REPUBLIC OF MEXICO.

1900.

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First Vice-President, Dr. Henry M. Bracken, Minneapolis, Minn.
Second Vice-President, Dr. Juan Breña, Zacatecas, Mex.
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Secretary, Dr. J. N. Hurty, Indianapolis, Ind.
[Next meeting will be held at Atlantic City, N. J., June 1 and 2, 1900.]

UNITED STATES MARINE HOSPITAL SERVICE.

Supervising Surgeon General, Dr. Walter Wyman, Washington, D. C.

SANITARY COUNCIL OF THE MISSISSIPPI VALLEY.

President, Dr. J. D. Plunkett, Nashville, Tenn.
Secretary, Dr. Charles O. Probst, Columbus, Ohio.

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MEXICO.

DISTRITO FEDERAL.

CONSEJO SUPERIOR DE SALUBRIDAD.

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Vocal, Dr. Augustin Reyes, Bajos de S. Augustin. 7.
Vocal, Dr. Domingo Orvanaños, Chavarria. 25.
Vocal, Dr. Nicolás R. de Arellano, Acequia. 5.
Vocal, Dr. Juan J. R. de Arellano, San Hipólito. 21.
Vocal, Dr. Luis E. Ruiz, Pte. de S. Pedro y S. Pablo. 14.
Vocal, Medico Militar, Dr. Fernando Lopez, 1 a. de Mesones. 11.
Vocal, Medico Veterinario, Profesor José L. Gomez, Cocheras. 12.
Vocal, Farmaceutico, Profesor José D. Morales, 2 a. de Vanegas. 9.
Vocal, Ingeniero Ing. Roberto Gayol, Cerrada to Santa Teresa. 4.

SECRETARI.

Secretario General, Dr. Jose Ramirez, 10 a. Violeta. 21.

UNITED STATES.

ALABAMA.

Dr. H. W. Sanders, *State Health Officer*, Montgomery. (The Medical Association of the State of Alabama constitutes the State Board of Health.)

ALASKA TERRITORY.

(Has no Board of Health.)

ARIZONA TERRITORY.

(Has no Board of Health.)

ARKANSAS.

Dr. H. C. Dunavant, *President*, Little Rock; Dr. R. G. Jennings, *Secretary*, Little Rock; Dr. J. M. Park, Little Rock; Dr. G. W. Hudspeth, Little Rock; Dr. R. N. Ross, Lonoke.

CALIFORNIA.

Dr. C. W. Nutting, *President*, Etna Mills; Dr. W. P. Mathews, *Secretary*, Sacramento; Dr. L. Bazet, San Francisco; Dr. D. Crowley, Oakland; Dr. R. W. Hill, Los Angeles; Dr. C. A. Ruggles, Stockton; Dr. A. M. Henderson, Sacramento.

COLORADO.

Hubert Work, M. D., *President*, Pueblo; H. R. Bull, M. D., *Vice-President*, Grand Junction; G. E. Tyler, M. D., *Secretary*, Denver; J. N. Hall, M. D., *Treasurer*, Denver; A. B. Harvison, M. D., Trinidad; D. I. Christopher, M. D., Colorado Springs; J. C. Chipman, M. D., Sterling; L. E. Lemen, M. D., Denver; Leonard Freeman, M. D., Denver.

CONNECTICUT.

Prof. Wm. H. Brewer, Ph. D., *President*, New Haven; Prof. C. A. Lindsley, M. D., *Secretary*, New Haven; G. H. Wilson, M. D., Meriden; R. S. Goodwin, M. D., Thomaston; T. H. McKenzie, C. E., Southington; E. K. Root, M. D., Hartford; H. G. Newton, Esq., New Haven.

DELAWARE.

Dr. E. W. Cooper, *President*, Camden; Dr. Alex. Lowber, *Secretary*, Wilmington; Dr. Frank F. Pierson, Wilmington; Dr. I. S. Vallandingham, Middletown; Dr. John W. Clifton, Smyrna; Dr. Edward Fowler, Laurel; Dr. Robert G. Ellegood, Concord.

DISTRICT OF COLUMBIA.

Dr. Wm. C. Woodward, *Health Officer*, Washington, D. C.

FLORIDA.

Hon. W. B. Henderson, *President*, Tampa; Dr. Joseph Y. Porter, *State Health Officer and Secretary*, Jacksonville and Key West; Hon. D. T. Gerow, Jacksonville; H. L. Simpson, M. D., Pensacola.

GEORGIA.

This State formerly had a State Board of Health, but has allowed it to become extinct from lack of appropriations.

IDAHO.

Has no State Board of Health. Provision is made for the appointment of health officers by the various boards of county commissioners, but they are answerable to the local authorities only.

ILLINOIS.

C. B. Johnson, M. D., *President,* Champaign; J. C. Sullivan, M. D., Cairo; R. F. Bennett, M. D., *Treasurer,* Litchfield; L. Adelsberger, M. D., Waterloo; Florence W. Hunt, M. D., Chicago; P. H. Wessel, M. D., Moline; M. Meyerovitz, M. D., Chicago; J. A. Egan, M. D., *Secretary,* Springfield.

INDIANA.

T. Henry Davis, M. D., *President,* Richmond; E. D. Laughlin, M. D., *Vice-President,* Orleans; J. H. Forest, M. D., Indianapolis; H. Jameson, M. D., Indianapolis; J. N. Hurty, M. D., Phar. D., *Secretary,* Indianapolis.

INDIAN TERRITORY.

(Has no Board of Health.)

IOWA.

J. A. Scroggs, M. D., *President,* Keokuk; J. C. Shrader, A. M., M. D., LL. D., Iowa City; Walton Bancroft, M. D., Keokuk; E. A. Guilbert, A. M., M. D., LL.D., Dubuque; J. A. McKlveen, M. D., Chariton; H. Matthey, M. D., Davenport; Hon. Milton Remley, *Attorney-General,* Iowa City; J. I. Gibson, D. V. S., *State Veterinary Surgeon,* Denison; Warren Dickinson, C. E., Des Moines; R. E. Conniff, M. D., Sioux City; J. F. Kennedy, M. D., *Secretary,* Des Moines; Prof. S. R. Macy, *Chemist,* Des Moines; Dr. Eli Grimes, *Bacteriologist,* Des Moines.

KANSAS.

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KENTUCKY.

Joseph M. Mathews, M. D., *President,* Louisville; J. N. McCormack, M. D., *Secretary,* Bowling Green; William Bailey, M. D., Louisville; G. T. Fuller, M. D., Mayfield; Arch. Dixon, M. D., Henderson; J. H. Samuel, M. D., Maysville; J. H. Letcher, M. D., Henderson.

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MARYLAND.

Dr. S. Chase de Kraft, *President*, Cambridge; Dr. John S. Fulton, *Secretary*, Baltimore; Dr. John Morris, Baltimore; Mr. J. B. Noel Wyatt, Baltimore; Dr. C. Hampson Jones, Health Commissioner of Baltimore City, *ex-officio;* Dr. Wm. H. Welch, Baltimore; Hon. Isidor Raynor, Attorney-General, Baltimore, *ex-officio;* Prof. W. B. D. Penniman, *Analyst*, Baltimore; Dr. Wm. R. Stokes, *Bacteriologist*, Baltimore.

MASSACHUSETTS.

Dr. Henry P. Walcott, *Chairman*, Cambridge; Dr. Frank W. Draper, Boston; Hiram F. Mills, C. E., Lowell; Dr. Julian A. Mead, Watertown; G. C. Tobey, Esq., Wareham; J. W. Hull, Pittsfield; Chas. H. Porter, Quincy; Dr. Samuel W. Abbott, *Secretary*, Boston; X. H. Goodnough, *Engineer;* Dr. Theobald Smith, *Pathologist.*

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Hon. Frank Wells, *President*, Lansing; F. R. Belknap, M. D., Niles; Hon. Aaron V. McAlvay, Manistee; Prof. Delos Fall, M. S., Albion; Collins H. Johnston, M. D., Grand Rapids; D. A. McLachlan, M. D., Detroit; Henry B. Baker, M. D., *Secretary*, Lansing.

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(Has no State Board of Health.)

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SOUTH DAKOTA.

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